COMPRESSED AIR MAGAZINE

DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR

Vol. xxiii DECEMBER, 1918 No. 12

OVER 15,000 COPIES THIS ISSUE

Published by THE COMPRESSED AIR MAGAZINE CO., Easton, Pa.
NEW YORK, Bowling Green Building LONDON, 165 Queen Victoria Street

Classified Buyers' Guide, Page 14. Index to Advertisers, Page 16.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Vol. xxiii DECEMBER, 1918 No. 12

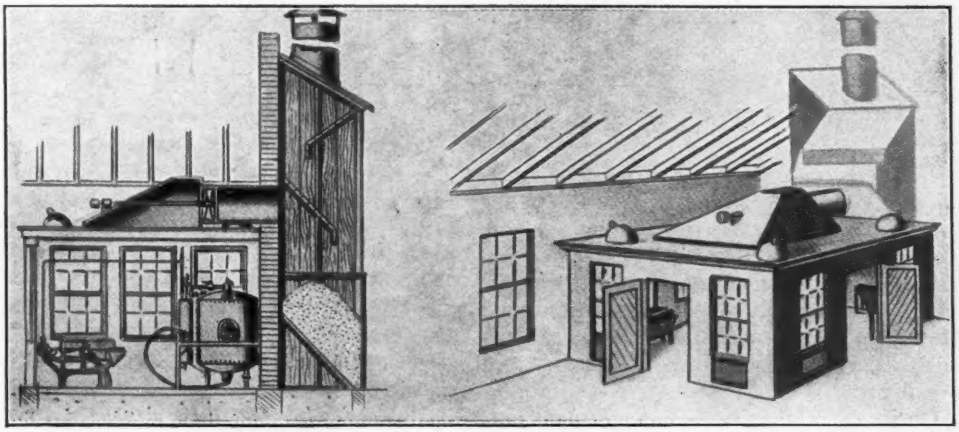


FIG. I. STANDARD SAND BLAST INSTALLATION

SELECTING SAND BLAST EQUIPMENT*

By H. D. Gates

Any discussion of sand blast equipment must recognize that probably no other class of men are as familiar with its operation as the foundrymen, for it was in the foundry that the sand blast found its first broad and general application.

Every foundry has conditions and operations peculiar to itself. Each installation should be an entirely individual problem; but it is far from such when the foundryman writes for "catalog, prices and delivery."

One of the largest establishments in its lnie in the United States, producing war material, sent out over the signature of its purchasing agent a so-called specification for a sand blast installation, asking "prices and delivery by return mail." The specification as written showed such lack of adaptation to the stated requirements that an engineer was immediately sent to ascertain existing conditions. Let us quote the engineer's report:

"I shall never forget Mr. Purchasing Agent. We seriously wounded his pride by hinting that his letter was not entirely sufficient to give an intelligent bid on his requirements. His response to my introductory remarks was: 'We are extremely busy here and perhaps your time also is limited. You have wasted valuable time in calling here that could have been used preparing data that would have been of service to us. Good bye!'"

A proposal, nevertheless, was made on this so-called specification, and it figured in the

*From a paper before the American Foundrymen's Association.

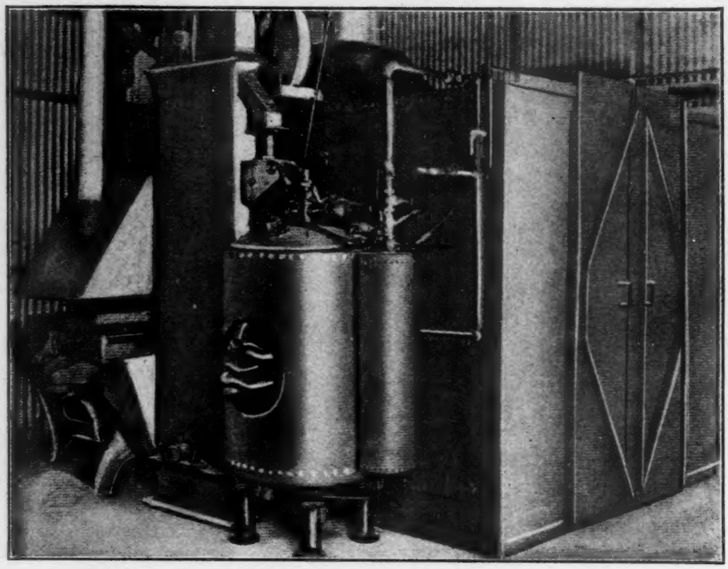


FIG. 2. STEEL PLATE ROOM WITH PRESSURE MACHINE

neighborhood of $20,000. Later another department asked for an engineer to call and go over the plans. A four-hour conference developed conditions that entirely eliminated the original specification and led to the substitution of a plan suggested by the sand blast engineer, with a saving of over $6,000 on the initial cost.

Obviously in the installation of sand-blast equipment the foundryman must turn to the manufacturer. The manufacturer's qualifications to give the service desired must include: Long and varied practical experience; an organization for the design, manufacture and installation of sand-blast equipment; physical and financial facilities for production; and a line so complete as to permit of unbiased counsel in suggesting equipment. A representative should visit the plant and make observations of conditions and operation. Men of the foundry organization who will be the deciding factors, should discuss the subject fully and thoroughly until their minds are met on what is needed. With plans and suggestions prepared the foundryman should go over them again with the sand-blast engineer until entirely conversant with the plan, the operation of the installation and the results to be obtained. Two or three conferences along these lines will save time, give a more intelligent understanding than is possible by proxy or corresponding and secure an investment that will pay a constant return. Keep the problem away from the purchasing end, for by training they can't see beyond the invoice figures, and money is not made there. Measure the price of the sand blast installation by the cleaning cost per ton.

Basically sand blast machines will divide into four general groups as follows: Hose machines; cabinets; barrels; and tables. The method of operation may be either the direct pressure, the suction (syphon) or the gravity systems.

DIRECT PRESSURE SYSTEM

In direct pressure systems the sand is under pressure in a sealed container, sand and air being discharged in combination without expansion through a hose nozzle giving the greatest velocity and highest efficiency possible. The majority of hose machines are of the direct pressure type, indeed, the first ap-

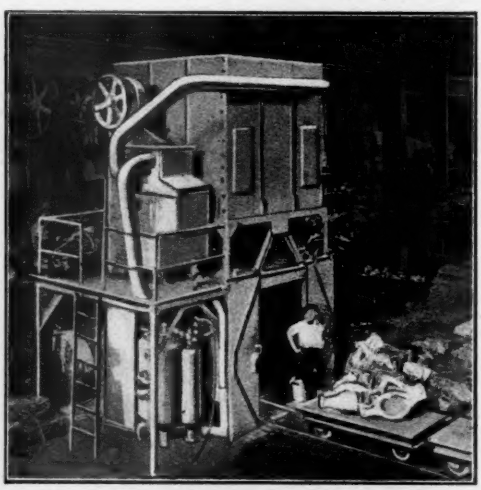


FIG. 3. SAND SEPARATING AND ELEVATING

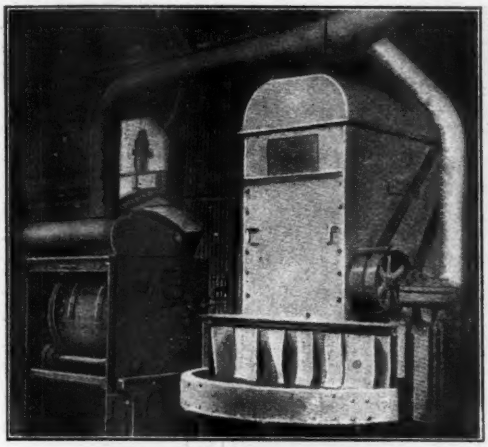


FIG. 4. ROOM AND BARREL

plication of sand-blasting was the hose machine type and it is still used without exception in sand-blast room installations. It offers a range of application that is possible with no other type. For a line and character of work that is varied and of medium volume it undoubtedly represents the most satisfactory equipment. Where the tonnage is large and the pieces are of a weight and size too great for convenient handling it is indispensable. The use of the hose machine demands some enclosure and experience has shown the wisdom and economy of a well ventilated and well lighted room for the purpose.

SAND-BLAST ROOMS

While the cleaning cost will always be reduced by mechanical methods of handling the work and the abrasive for reuse, a convenient room can be provided with small outlay and may be built of rough lumber as shown in Fig. 1, with an exhaust fan in the ceiling or wall, carrying the dust-laden air into a settling box or chamber that will retain the heavier particles. The lighter material is carried off into the atmosphere.

The inclusion of mechanical handling and screening of the abrasive makes a steel room most advantageous and economical. The simplest of these provides for the location of the sand-blast outside the room which is left free for the blasting operation, with controls extending inside to within easy reach of the operator, as illustrated in Fig. 2. A mechanical separtor, driven by a powerful air motor, removes both fine and coarse material at one operation. The clean, sharp abrasive for reuse is delivered by an elevator to a sand storage bin above the sand blast machine for refilling. In this type of room the speed abrasive is shoveled from the floor to a chute in the side of the room connected with the separator.

EXHAUSTING DUSTY AIR

Some diversity of opinion is expressed as to the most satisfactory system for removing the dust laden air. Theoretically it is desirable to keep the dust in transit below the operator's head, and this theory creates some adherents for the downdraft system whereby the dust laden air is drawn downward through the grated floor. Failure in practice to keep the gratings clear, however, seriously retards circulation and experience has demonstrated that more positive results are obtained from an updraft, where there can be no interruption to the draft, and generally better operating conditions are secured.

In considering claims for conditions provided within sand-blast rooms common sense tells us the dust is there, and no improvement is possible over its removal as fast as produced. Not only is this rapidity of removal essential from the standpoint of hygiene and sanitation, but equally so to provide clear vision for efficiency in cleaning. Obviously protection for the operator from the dust-laden air and the flying abrasive other than afforded by the exhaust system must be provided. The most satisfactory device is a dust-proof ventilated helmet. Air is introduced into the helmet from the compressed air line, to which the helmet is connected by a small flexible hose, weighted over pulleys to take up slack in any position and permit ease of movement to the operator.

ROOM EQUIPMENT

Some foundries having sufficient tonnage of both large and medium work have obtained a reduced cleaning cost by installing a battery of two or more rooms, equipping each as the proportions of the work demand with car or table, as shown in Fig. 6.

The rotative tables are up to 90 inches in diameter and have a high partition across the center that completely closes the aperture in the room structure. The material to be cleaned is loaded onto the exposed half of the table, outside the room, by common labor;

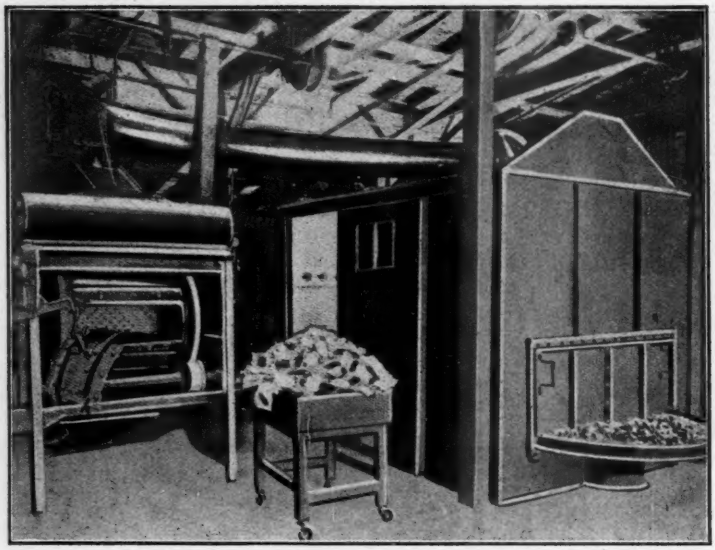


FIG. 5. AUTOMATIC REVOLVING TABLE MACHINE

the table travels on ball bearings and is turned by the sand-blast operator to expose the cleaned work for unloading and to bring new work into the room for cleaning.

The entire time of the sand-blast operator should be devoted to the cleaning operation only. The handling of the work to and from the room should be done by other help. Frequently two operators are worked in a shift. While one is sand-blasting the other is delivering cleaned work and bringing up the new material for cleaning. Each thus handles and cleans his own work, which, in addition to giving continuous operation of the sand-blast, provides a periodical change of occupation.

Where the work is of a character requiring room cleaning and still all within the range of sizes to admit of cleaning on the rotative table; the hygienic table cabinet, Fig. 7, offers advantages. A semicircular cone-top steel cabinet fits closely to half the circumference of the table, the upright partition across the center of the table entirely closing the rear of the cabinet leaving half the table exposed. In the front of the upright wall of the cabinet and extending the entire length is an opening covered by a flexible sectional rubber curtain that retains the abrasive within the enclosure and through which the hose nozzle from a direct pressure blast is directed onto the work to be cleaned. Unobstructed view of the work and interior is provided through a screen covered opening in the cone. Electric light fixtures provide satisfactory illumination.

CABINET AND BLAST

The cabinet sand-blast, a self-contained unit ready for instant use when attached to the air line, is essentially an auxiliary in foundry sand-blasting. The blasting operation is of the suction or syphon type. The abrasive is brought to the nozzle by a partial vacuum created by a jet of compressed air. The air and abrasive are discharged in combination through the sand nozzle, which, being of greater diameter than the air jet, admits of expansion with correspondingly decreased velocity, so that while the blasting efficiency with equal gage pressures is below that of the direct-pressure type, it is a most satisfactory device for special or precision work not economically handled by a large installation. The floor of the cabinet being perforated, the spent abrasive flows back to the feed box, giving a continuously operating machine.

SAND-BLAST TUMBLING BARRELS

For small work in any considerable amount, and particularly where no detriment to the pieces would result from the slow rolling process, no device shows the speed and economy of the barrel sand-blast. While the first adaptation of this system, consisting of placing the nozzle of the hose sand-blast in the ends of a revolving barrel, is still seen in some types, refinements have brought the barrel sand-blast a secure position of its own.

For small brass and malleable work that has been cleaned before annealing, the suction type will be found entirely efficient and has the advantage of a single self-contained unit with low first cost. Three or four nozzles, according to size, cover the entire length of the drum and in the highest developed types the nozzles are adjustable as to direction of different characters of work. This construction, too,

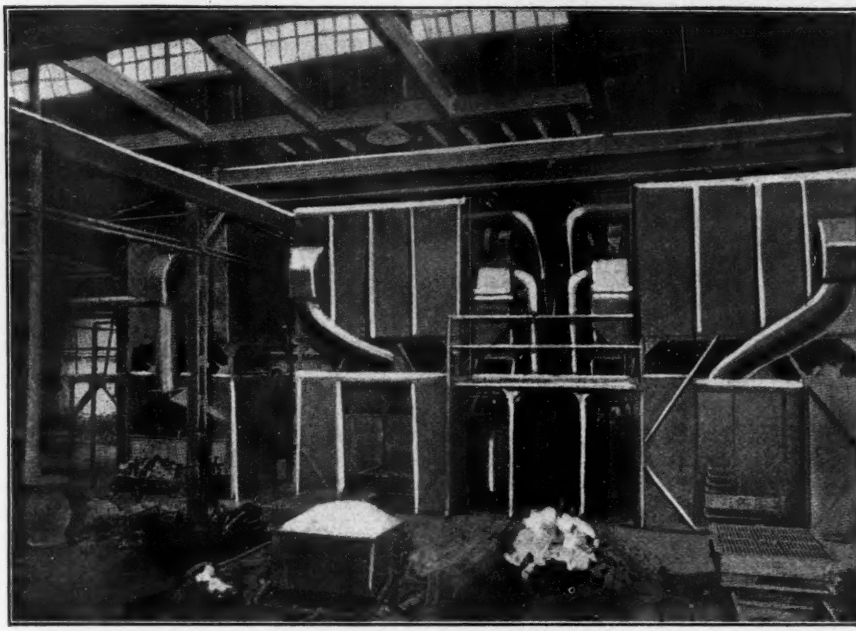


FIG. 6. ROOM WITH TABLE AND CARS

permits the elimination of projecting nozzles that may catch and damage the work or the machine, as well as offering an inswinging door that allows removal of the load by dumping without raking or other handling.

Large castings of either brass, iron or steel demands a heavier design, and the combination of such a barrel with a room installation will take care of a considerable output of varied work. The blasting action is of the gravity type, the abrasive being delivered to the nozzles by mechanical action and gravity; in portion of the force of the air is expended in raising the abrasive, and as the ratio of the air jet to the sand nozzle is greater than in the suction system, less expansion of the air takes place with proportionately increased blasting efficiency. The nozzles are located in each end of the drum, leaving the interior entirely unobstructed so that the size of pieces that can be cleaned is limited only by the dimensions of the door opening. The abrasive passes through perforations in the drum and falls into a hopper that conveys it to the elevator boot. As it is delivered from the elevator, a strong exhaust removes the fine light material, and vibrating screens reject everything that will not readily pass the nozzle, giving a continuous flow of evenly graded, clean, sharp abrasive. For the foundry whose product is of a size and character that will admit entirely of barrel cleaning, there is no one other device that is as economical and satisfactory.

AUTOMATIC REVOLVING TABLE TYPE

There are classes of work that by reason of shape do not adapt them to barrel cleaning. This includes precision work or pieces that are so light and fragile as to not admit of this method of sand-blasting, and are yet too small for individual cleaning to advantage with the hose machine in room installation. For this character of output the automatic revolving table sand-blast, Fig. 7, has found high favor. A grated-top table half exposed and half housed revolves at a slow speed. Within the housed portion a series of nozzles, fed from a direct high pressure hose blast, are oscillated in adjustment with the varying peripheral speeds of the table, so that all points are brought with equal duration within the path of the blast stream. The pieces to be cleaned are placed on the exposed portion of the table as it revolves; they are turned as required and removed when cleaned. A flexible sectional rubber curtain permits passage of the pieces to and from the housing

while retaining the abrasive within the enclosure and protecting the operator from dust and flying particles.

ABRASIVE MATERIALS

The metal abrasives have many times the life of sand, do not require large storage capacity and create less dust in use. Their comparatively high initial cost demands careful reclaiming methods, as any considerable daily loss soon wipes out the saving their long life affords. To some lines of work they do not successfully lend themselves without after-cleaning of the pieces, as the fine metallic dust adhering by force of the blast creates defects in galvanizing, plating, etc. Moisture in the air lines, too, is a decided deterrent to the use of metal abrasions, due not only to the fact that they do not flow freely when damp, but may readily rust into a solid mass.

Of the various sands offered silica and ocean sands only have the sharpness and hardness to make a satisfactory sand-blast abrasive. At the same, or even an advanced cost, undoubtedly the silica sands would have a general preference. Owing to the restricted areas of production, however, freight rates operate against their use at any considerable distance from the source of supply. It is only by a trial of each that an intelligent selection of available sands can be made, and some initial expense in comparative tests of all the various sands and metal abrasives will undoubtedly be fully returned in satisfactory results and economy of sand-blast operation. Highest blasting efficiency from any abrasive, however, may only be anticipated when it is evenly graded, dry and free from loam and dust.

TROUBLES IN PRACTICE

Operating troubles may usually be traced to three general causes, air pressure, moisture and abrasive. An installation that fails to provide for adequate control and regulation of these can hardly be called complete or expected to give maximum results.

All other factors being normal, air pressure governs results. When it is remembered that results at 20 pounds pressure are but half that at 56 pounds; at 30 pounds half that at 64 pounds, and at 40 pounds half that at 72 pounds, it is seen that the increase in output and saving in labor will demand the maximum pressure that the character of the work will permit. Obviously soft brass will not stand the pressure required for cleaning steel, nor will the molding sand fuse and burn to the casting in a degree to demand such high pressure.

Air volume should be ample and the flow steady. Air means horse-power, which in turn costs money, and the air volume should be restricted to the minimum to obtain the required results. As the flow of air increases four-fold with increases in the diameter of the nozzle, restriction at this point is most essential. It means not only a constant saving in operating cost, but in the case of limited air supply, increased air flow may cause a drop in pressure with a corresponding reduction of output.

This feature cannot have too careful attention. For example, a new nozzle with ¼-inch diameter opening, *A* and *B*, flows, at 80 pounds pressure, 85 cubic feet of free air per minute. If the nozzle enlarges with use, *D*, an increase of 1/64-inch increases the air flow by 12.5 per cent. With a 1/32-inch increase in diameter the air flow increase is 27 per cent. and by a 1/16-inch increase in diameter the air flow has increased 56.5 per cent. The nozzle should retain the original inlet size as it wears at the discharge end. Not only economy dictates this but it permits of predetermined air and horsepower requirements.

It is rather past conception that anyone would permit water to get into the gasoline tank of his automobile. The results would be disastrous, but how many are making provision to eliminate the water from their compressed air lines? In many cases, the air passes the "moisture" stage, and trouble is immediately experienced.

Moisture is detrimental to all air-operated tools and as it is variable with weather conditions some provision for its elimination before delivery to the sand-blast or to other tools is the truest economy. Various devices are produced for this purpose and where the moisture volume is not abnormal a simple separator, consisting of a vertical tank fitted with a series of solid and perforated plates in pairs placed at a slight angle from the horizontal is effective. The air supply pipe is carried to the bottom and is copped at the end, the air being discharged through small holes aggregating the area of the pipe suction. From the bottom of the tank the air passes through the openings in the perforated plates striking the

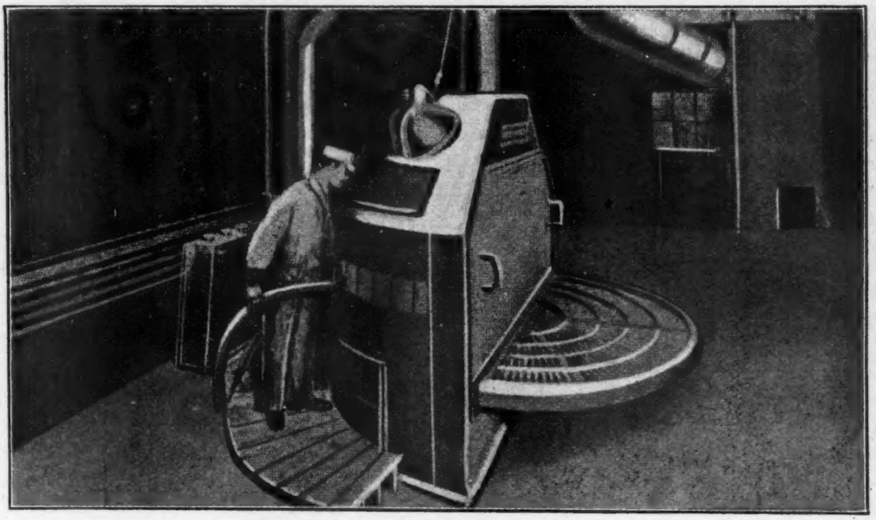


FIG. 7. HYGIENIC TABLE CABINET

solid plates immediately above each and passing around the outside to the next series, this operation being repeated several times until finally it reaches the top of the separator and flows through the outlet to the sand-blast machine.

The principle involved lies in the fact that when air at high pressure and velocity is compelled to take an abrupt change of direction, the heavier particles of air, containing the moisture, by their momentum will strike the walls of the apparatus in which the change of direction takes place. This causes compression of the particles of air which tends to separate out the moisture and deposit it against the walls of the vessel.

Where the moisture is excessive, even if only at certain seasons, an aftercooler or a reheater is a necessity. While the aftercooler is most effective, some plants have found satisfactory relief in the reheater, although its function is not at all that of eliminating any of the moisture.

Each function in the operation of a sandblast is to an extent dependent on the perfect operation of the others. Therefore maximum results cannot be anticipated from the poor or powdered abrasive even with dry air at high pressure. Both sand and the metal abrasives show some disintegration with use and the fine dust together with core and molding sand and all fine material must be removed constantly from the abrasive. This material has no abrasive ability, but it consumes air just the same.

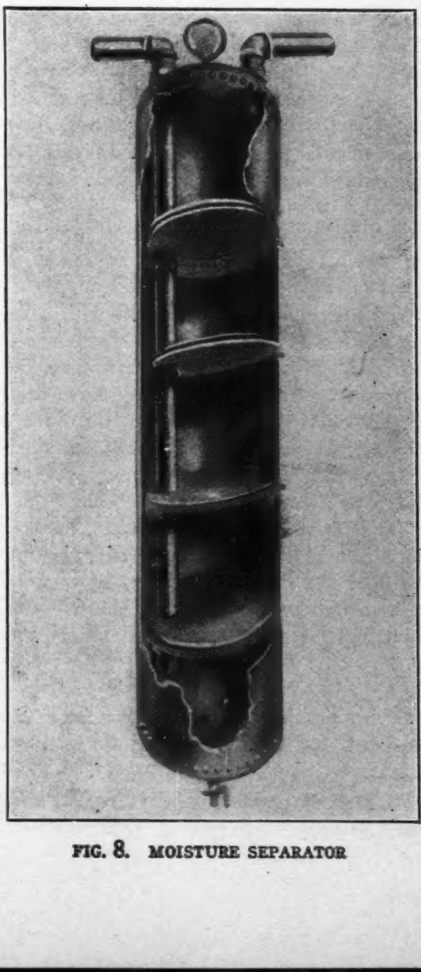


FIG. 8. MOISTURE SEPARATOR

Clean, sharp, dry abrasive graded to the requirements of the work will increase the output amazingly. A thorough understanding and application of basic principles will save time, worry and expense. The help of a competent service man will often more than repay the expense entailed particularly if some one in authority in the foundry organization will cooperate.

VARIOUS SALVAGE FEATS*

By ROBERT G. SKERRETT

Within the last few months the United States has become represented in the Joint Salvage Council of the Allies. Besides sending to Europe some of the best of our civilian and naval salvage experts, we have equipped and dispatched a number of vessels uniquely fitted for the speedy and effective handling of damaged or sunken ships.

The first work of our experts sent to the other side was to study conditions and to devise ways in which we could act to best advantage. The salvage steamers since prepared for the service embody everything thought essential to effective operations, and reflect the judgment of men whose brilliant achievements in a peculiarly difficult branch of engineering have placed us in the very forefront of the art.

Our salvage corps in Europe, however, is not succoring or refloating American ships only, as was originally intended. We have pooled our skill and equipment with those of our allies and are now actively coöperating with the Salvage Department of the British Admiralty. And that we may have an idea of the capacity of the men we have sent abroad, just let us review briefly some of the amazing things they have done in American waters in the past few years. They tell better than anything else just what Yankee resourcefulness really means—a resourcefulness that does not hesitate to put tried agencies at work in untried fields and by means of sheer audacity to accomplish the seemingly impossible.

THE ROYAL GEORGE

To begin with, there was the S. S. Royal George, a big liner of fifteen thousand tons, which ran high upon the rocks in the St. Lawrence—that graveyard of ships—while racing seaward during a heavy fog. Substantially forty per cent. of her underwater plating was damaged and great rents torn in her steel skin, through which the river ebbed and flowed freely.

The vessel had in her at the time of her grounding only a moderate amount of cargo, and there was, therefore, comparatively little that could be taken out of her to lighten her. This was done, but it failed to break the grip of the bowlders that had pierced her bottom; and it was found impossible to drag her off bodily, despite the efforts of a flotilla of powerful tugs, augmented by a number of larger steamers. To make things worse, the rise and fall of the tide was a matter of sixteen feet, and the Royal George struck at high tide.

A New York salvage expert was summoned to Quebec and, undismayed by the problem, promised to get the ship off; and he did so. He sealed the decks and hatches above the injured holds, fitted air locks to the hatch covers, and then went ahead as if his job were one of subaqueous tunneling. He turned compressed air into the flooded compartments, and in an astonishingly brief span of minutes forced the invading water down and outward through the rock-torn gaps until the water was level with the top edge of the uppermost injury. Then he sent his gangs of sand hogs down through the air locks into the holds.

These men, who had also learned their trade in driving tunnels under rivers, laid planks over the wounds, starting at the top of each, and filled the crevices with clay. The compressed air helped to hold these "pudge" boards in place and at the same time drove the water down and out as the rents were gradually covered. In this way the Royal George was given sufficient buoyancy to raise her clear of the river bed and permit her to be towed into deep water; but this was only half the task.

Winter was near at hand and with it the likelihood of the St. Lawrence's freezing before the liner could be taken to the nearest dry dock and made fit for sea. A great deal of money was at stake, and her owners wanted to get her back to England so that she could be overhauled and made ready for service. The situation was met in a thoroughly orig-

*Abstracted and condensed from *The Saturday Evening Post,* Oct 26, 1918.

inal manner: the steamship was repaired just where she floated.

THE SAND HOGS

The sand hogs made patterns of the patch plates needed to seal each wound in the hull. These patterns showed, also, just where threaded bolts were to be screwed into the patch plates, and these marks corresponded exactly with others placed around the injuries, where holes were drilled through the sound steel of the hull and temporarily plugged with wooden stoppers from within.

As each patch plate of steel was made ready it was lowered over the side and brought into position by divers standing upon a submerged and weighted platform. At the right moment the wooden stoppers were pulled out and the bolts on the patch plate shoved inward. Working quickly, the sand hogs fitted the nuts on the bolts and screwed them tight. The repairs thus made were found, when the ship was docked for inspection, to be so sound that nothing more was done on her at the time, and the Royal George ran to England with a profitable cargo.

THE URANIUM

Again, the steamship Uranium, bound for New York via. Halifax, stranded upon the rocks just outside that Nova Scotia port. She was refloated after five days of work and towed into Halifax; but the only suitable dry dock was occupied. Her bow and forward bottom were so seriously damaged that it was quite impossible for her to put to sea in that condition.

Compressed air, resorted to by an American salvage expert, saved the day. The wounds were covered from within with sheets of flexible lead so bent that they fitted snugly over the rents. Upon the lead sheeting was laid a mattress of cement. When the injured compartments were charged with compressed air the patches were held securely. The craft reached New York after a two days' run, carrying a valuable cargo.

THE ZEELAND

There was the case of the steamship Zeeland, driven far up on the flats of the St. Lawrence in a fog. The mud was dredged from both sides of her and a path was dug sternward back to the channel, and the ship was lightened by discharging, coal, water ballast and portable equipment, but powerful tugs and other craft were unable to pull her from her bed of mud.

AIR BUBBLES DID IT

The man who salved the Royal George released the Zeeland. He did it by means of a film of air bubbles discharged from holes drilled in the bottom of the liner. The air passing outward and upward broke the suction grip of the mud, freed the ship and she was then towed back into the river fairway.

THE GUT HEIL

Every salvage case is different from every other. There was the big tanker Gut Heil, sunk in the Mississippi, which was raised by compressed air after lying abandoned for five years. She had turned over on her side and was filled with hundreds of tons of mud, and the problem was to turn the ship upright in shallow and nontidal water and then to refloat her.

Compressed air did the trick. Buoyancy so obtained and carefully distributed righted the ship after she had been freed of the bulk of the mud inside. The task involved the nicest sort of juggling with water ballast and buoyant air so that the ship would come slowly upright and then not lurch over on the other side. The feat as a whole was without a parallel in marine wrecking.

THE DIVERS

These are the most important and responsible workers in wrecking operations. The operating zone has been greatly extended so that operations are carried on at greater depths and the worker is no longer hindered by the air hose. Compressed air is now drawn from storage flasks so that with an ample and unfailing flow of this vital element assured it is now possible for the diver to control his air supply to a nicety and to meet confidently the changing requirements. It has also been found to be practical and safe to reduce considerably the length of time a diver must remain in the water when coming up from a deep descent in order to bring about a readjustment of physical conditions. By the prompt use of the recompression chamber, one of which is on each of our salvage boats, the development of "bends" can be prevented and the aftermath of still graver bodily reactions effectually offset.

THE BRITISH WORKERS

With our men collaborating with the English and French experts there is good reason to believe that 1918 will prove a bumper year

miralty's Salvage Section was devoted to taker's U boats. One of our own sailors has paid this spontaneous tribute to his English professional brethren:

THE CELTIC

"For sheer grit and dogged persistence, I take off my hat to the British wreckers. I first saw them in action when they made port with the torpedoed Celtic last April. She was hard hit. Her great bulk of twenty-one thousand tons was made heavier and more difficult to handle by reason of the water that had poured into her through her gaping side. The Irish Sea at that particular time was in an ugly mood, thanks to a nasty wind; and, believe me, it was a man-sized job to get hold of that ship and to tow her into a haven, all the while battling with the threatening sea to keep the craft from filling up and going to the bottom.

"The Celtic was potted somewhere in the neighborhood of the entrance to St. George's Channel, where a number of other big ocean-going vessels had fallen prey to lurking U boats. Within an amazingly brief while after she sent out her S O S calls, a flotilla of salvage vessels and tugs were gathered about her.

"The stricken craft rolled deeply and sluggishly as the waves beat angrily against her massive hull. The salvors' problem was to get alongside of her for the twofold purpose of putting pumps aboard and of securing lines by which she could be towed into harbor. Her fires were out and her own pumps were, therefore, incapable of helping.

"The little salvage vessels stuck valiantly to their job, even though more than one of them was smashed grievously against the liner's steel body. Despite all handicaps, the wreckers toiled undismayed and finally loaded their self-propelled pumps on the sloping and slippery deck of the wounded Celtic. With these powerful pumps the salvors fought on more nearly even terms with the menacing sea, and were able to work the injured liner heavenward and to guide her safely through mine fields to safety."

Up to date the Salvage Department of the British Admiralty has been able to restore to service four hundred and fifty sunken or damaged ships. The British Navy, with its enormous peace-time fleet, was well nigh entirely lacking in salvage facilities until the concluding months of 1914. At the start the Admiralty's Salvage Section was devoted to taking care of stricken battle craft, but by October, 1915, its main function had become that of dealing with damaged or sunken merchantmen.

The man chosen to head the newly formed department of the Admiralty is not a naval officer. He is a practical and very successful marine salvor. Captain Fred W. Young, the man in question, is a bluff, seatanned type of British mariner who scoffs at gold trappings and prefers to work in his shirt sleeves.

SUBMERGED PONTOONS

Ten years ago he wrought a salvage wonder when he turned over H. M. S. Gladiatas, lying on her side in the open waters of the Solent, and refloated that dead weight of six thousand tons notwithstanding the fact that the cruser had a hole in her side fifty feet long which reached from her gunwale down to within a few inches of her bilge keel. He did this by means of submergible pontoons. Since then he has gone on adding to his laurels. No wonder the lords of the Admiralty have given him a free hand.

Captain Young first recruited from civil salvage enterprises a corps of experts and a force of divers familiar with the waters contiguous to the British Isles; and he also requisitioned some of their vessels. The next step was to outfit a goodly number of obsolete gunboats by placing aboard an array of portable pumps, no end of piping, long lengths of chain cables, heavy wire hawsers, massive blocks, diving gear, air compressors, oxyacetylene blowpipes for cutting metal, line-firing guns, wireless apparatus, and a long list of paraphernalia peculiar to the wrecking business.

Quite eighty per cent. of the work of the Admiralty Salvage Department lies in succoring a wounded ship before she can go to the bottom in deep water, as instanced in the case of the Celtic.

THE STANDARD PATCH

A large freighter, laden with a cargo of foodstuffs valued at fifteen million dollars, was torpedoed in the home waters, and went to the bottom in fairly deep water. Her shelter deck, fifty-seven feet above her keel, was just awash for about two hours at low tide. The torpedo that got the ship tore a hole in her side forty feet long and twenty-eight feet wide. Before the war a craft so circumstanced would, in all likelihood, have been declared a total loss; but the Salvage Department looked upon

her as a promising problem, and Captain Young's men tackled that job, fortified by special facilities which had been developed or perfected since 1914. Among these are the submergible electric pump and the so-called standard patch.

Pumps were placed deep down in the submerged stokehold of the freighter, and by the aid of divers accustomed to the perilous work of exploring the interior of sunken ships holes were drilled and blasted in divisional walls of steel, so that the water could drain into a common sump, and thence be discharged to the surface. In this way the freighter was lightened so that part of her cargo could be removed and her position shifted to shallower water. There she was temporarily patched, thousands of tons of the goods aboard were unloaded, refloated by further pumping, and then towed to port for permanent repairs.

The so-called standard patch is really an adaptation of the patch plates devised for the repair of the S. S. Royal George. It is doubtful whether our American experts will use it at all, since the patch plate is believed to be easier to make and susceptible of quicker adjustment. The standard patch, however, has proved of undeniable value, and has made it possible to save many a vessel that might still be resting on the sea bed. It is fashioned of planking six inches thick, strengthened by metal strips, and modeled so that it will fit snugly against the outside of a ship and effectually cover the injured area. The form of this patch depends upon the shape of the vessel and the particular part damaged. First, divers are sent down with an adjustable mold of wood prepared after the known contours of the craft in question; and the underwater workers set this against the hull and mark just how the patch must be made to seal the hole. After that, the patch is constructed ashore or possibly on one of the salvage vessels. When ready it is lowered over the side and guided into place by divers working both outside and within the wounded craft; then it is drawn snugly into place by means of hawsers attached to the inner face of the patch and leading into the vessel; finally the timber shield is secured firmly by bolts passing out through the sound shell plating of the hull.

THE O. B. JENNINGS

The American tanker O. B. Jennings, carrying sixteen thousand tons of oil, collided last April in the English Channel with a large freighter, also partly laden with oil and other highly inflammable commodities. The stem of the latter vessel tore a great rent in the tanker's side and the friction caused by the impact set the Jennings aflame. The rescuing tugs found it impossible to subdue the blaze, and to save the splendid ship and her valuable cargo she was deliberately sunk by gunfire. Divers afterward closed the wound occasioned by the collision and plugged the holes made by the shells. The Jennings was raised, towed to port, and temporarily repaired and run to the United States for thorough overhauling. On the fifth of August, unfortunately, the tanker was attacked by a U boat off the coast of Virginia when homeward bound and sent to a watery grave.

The British ship that collided with the Jennings took fire also, and the explosions that followed killed pretty nearly all of her crew. Notwithstanding she was so dangerous as a powder magazine, the wreckers undauntedly approached her to save her. The character of the men in the salvage flotilla was splendidly evidenced by their courage in boarding the flaming freighter in order to attach hawsers so that she might be pulled stern first against the wind for the purpose of preventing the spread of the conflagration within her. After towing the vessel for nine hours a mine exploded under her, parting one of the cables, and a moment later two other mines burst beneath her stern. Finding it impossible to get hold of her again, the craft was sunk by gunfire near an exposed inlet on the south coast of England. The steamer has since been raised.

DANGEROUS GASES

Certain cargoes—such as grains, other vegetable matter, meats, and so on—when exposed to the action of sea water give off poisonous gases, and these have proved extremely troublesome and even fatal where the men were unfamiliar with their noxious character. One of the worst of these has been sulphureted hydrogen, generated by decomposed cereals. The chemists who have done so much toward developing antidotes for the treatment of soldiers gassed on the firing lines have found ways to neutralize the cargo gases, and the simple expedient of spraying the rotting freight with a prescribed mixture has practically disposed of the asphyxiating menace. Some chemicals essential to waging war also

react when exposed to water and give off both poisonous and explosive gases, and these can be disposed of successfully only by stimulated ventilation and by taking other precautionary measures.

For instance, one American salvage concern was called upon to refloat a ship sunk in the harbor of St. John, New Brunswick. Among the cargo were a good many tons of calcium carbide, which, when water worked into the containers, gave off acetylene gas and also heated the metal tanks to the point of red-heat. At low tide the whole inside of the ship above water was filled with the gas, and the explosive fumes remained in pockets when other parts of the craft were cleared of it by ventilating blowers. As a very low percentage of acetylene in the air makes an explosive mixture, it was necessary to devise some form of detector. As a result an ingenious and simple gas gun was evolved, and by taking samples of the atmosphere within the steamer it was possible to tell quickly and surely whether danger lurked there for the wreckers. The gas gun will play a helpful part abroad among the craft of our salvage flotilla.

The question naturally arises: What can be done in cases of ships a hundred and more feet down? A submarine, because of the pressure-resisting type of hull and its normal fitness to run under water, lends itself exceptionally well to raising by means of compressed air applied internally so as to provide buoyancy while expelling the invading water. This is not practicable in the ordinary ship, unless she be in a position where it is possible for divers to work inside her, strengthening her decks, sealing hatches, and otherwise bracing her to hold, without rupturing, the expansive or bursting force of the confined buoyant air. Therefore, the main refloating agency will, in most cases of deeply sunken craft, have to be applied externally in the form of a direct lift and through the medium of pontoons.

THE SALVAGE OPPORTUNITY

We have proved practicable, in times of peace, salvage tasks that the British have essayed only under the impelling stress of war. Again, a desperate shortage of sea-going tonnage has brought about wrecking feats that would probably not have been dreamed of commercially because of the great expense involved. However, with substantially unlimited funds now at their disposal, the salvage engineers are taking long chances and doing amazing things. Meantime they are learning much that will cheapen operations in the years to come, when the wreckers will be asked to consider with the cold eye of business the question of refloating or raising hundreds and hundreds of ships which now, for various reasons, cannot be given consideration.

We have gone to Europe to help in a great work and our men can be counted upon to do their part in offsetting the ravages of the Kaiser's U boats. They are likewise over there to profit by the experience of the British, French and Italian salvors. The men who in this fashion are fighting the sinister Teuton sea asps, who are battling with the treacherous, changeful sea, and who are trying to minimize navigational accidents induced by dimmed beacons and blinded running lights, are, indeed, a splendid body. They are facing perils and struggling with difficulties that demand complete self-forgetfulness and unfaltering determination to succeed and, if it be physically and humanly possible. Theirs is a he-man's job; and they are tackling it like red-blooded, two-fisted fighters. They are heroes—all of them.

VENTILATION AFTER MINE EXPLOSION

In the event of the ventilating fan or appliances having been injured, wrecked, or destroyed by the force of an explosion immediate attention should be given to the repairs necessary for reëstablishing the ventilating current. In a drift or slope mine, advantage should be taken of any natural ventilation that has become established. In a shaft mine advantage should be taken of any natural ventilation in exploring on the intake current, especially on ladders and stairways in any shaft through which such natural ventilation is supplying fresh air. Men may be found alive on the stairways. To aid natural ventilation or to establish a current of air in the absence of such ventilation, a spray of water may be directed down one of the shafts to cool the air and cause the shaft to become an intake. On the upcast air compartment a steam jet may be installed to heat the air. The jet should always be placed in the compartment of the shaft in which there are steam pipes, as the heat from the pipes will assist in warming the air and help to make an uptake current.—*Rescue and Recovery Operations in Mines.*

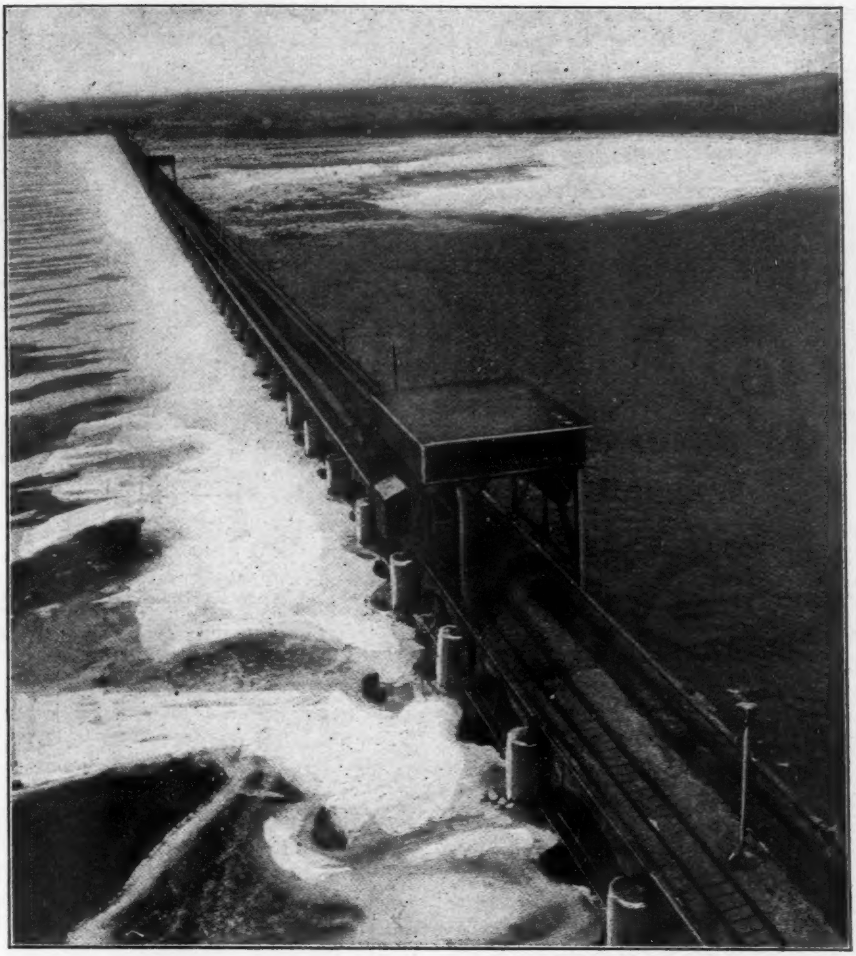


FIG. I. KEOKUK DAM PROTECTED BY COMPRESSED AIR

COMPRESSED AIR CONQUERS ICE THRUST

The following interesting narrative is compiled substantially from an article in the *Stone and Webster Journal,* March, 1918. Being a narrative of winter operations it should be of more suggestive practical value when anticipating the cold season than when supplementing it. The application of compressed air here described was quite unusual and proved far more efficient than could have been predicted.

Heavy ice above the Keohuk Dam on the Mississippi caused serious trouble during the winters of 1915-16 and 1916-17. During the first of these winters heavy floating ice battered and crowded out one of the spillway gates, and in the following winter a steady pressure of thick ice caused permanent deflection of a number of the many gates spanning the spillway openings, which extend all across the river. To prevent the recurrence of such conditions, early in the winter of 1917-18 a system was devised whereby dry air under pressure was forced out in front of each gate, so agitating the water there as to prevent the formation of ice.

In general, there are three ways in which pressure from heavy surface ice may be exerted. First, a moving mass of ice may exert pressure by virtue of its inertia. Such an occurrence took place during the winter of 1915-16 at Keokuk. An unusually mild January

thaw came while the river was full of heavy ice, which at Keokuk collected in a gorge about four miles above the dam. The pressure of the gorge against the smooth ice cover, about 14-in. thick between the gorge and the dam, finally became too great and the whole ice field, 4 square miles in extent, moved steadily about 40 ft. toward the dam. The gates on the dam withstood the impact without injury, but the shore structures near by were in many cases seriously damaged. Severe cold followed this thaw, and froze the mass of ice in the jam solid, thus arresting any further action for the time being. By the latter part of March practically all of the ice in the lake had melted except the heavy part of the jam. This floated aimlessly about the lake until one morning it was driven down the stream by a heavy wind, acting with the current. The nose of this mass of ice, several acres in extent and from 3 to 6 ft. thick, struck one of the gates squarely and carried it out. It is estimated that to cause such a rupture the ice mass must have exerted a maxmuim force of 92 tons.

A second type of pressure, the author states, may be exerted by ice when it forms on a confined space, and a third type is the pressure exerted by the expansion of a solid field of ice when its temperature is increased. With regard to this third type Mr. Davis says:

"Contrary to the common idea, ice has a coefficient of expansion just as any other solid. In fact, its coefficient per degree F. is 0.000029, or about four and one-half times that of steel. The range of its temperature is small, however. While the temperature of the upper surface of the ice may be—10° F. at times, the under surface will always be at 32° because of its contact with water. Hence the average temperature of the ice can never be much less than + 11°, and the range of temperature cannot exceed 21°. The expansion in a solid ice field a mile long amounts to 3.2 ft. for this increase of temperature.

This type of pressure is not noticeable until the ice becomes solid and from 10 to 12 inches thick. It is first manifested by ice pushed up on the shores of the lake and by ridges of buckled ice running across from shore to shore every mile or so along the river, thus dividing the whole ice cover into fields about a mile square whose centers remained fixed and whose edges are in constant motion while the temperature is changing. An expansion is followed by only a slight contraction when the temperature falls again. Thus there may be an accumulated expansion amounting to 6 ft. or more. A covering of snow on the ice, which to a certain extent insulates the ice from the upper air, will prevent sudden changes of temperature and may, if the snow is 12 in. or more deep, entirely eliminate expansion with changes of temperature.

Such a development of pressure took place at Keokuk in the winter of 1916-17. Heavy ice formed on the lake during a prolonged cold spell to a maximum thickness of about 20 in. A severe cold snap, with a minimum temperature of 18° below zero, was followed by a short rise of temperature to about the freezing point, and under this sudden rise the ice expanded. The rounded faces of the piers tended to break up the ice pressure against them and make the gates take the thrust of the whole ice field. Fluctuations of pond level combined with the enormous energy of the heavy ice field caused local pressure sufficient to deflect permanently three of the gates, the maximum deflection being about 2½ in.

When this condition occurred in 1917 remedial measures were taken by thawing slots about 3 in. wide clear across the front of practically every gate on the dam. This thawing was done by steam discharged through a horizontal perforated pipe half the length of the gate. The slots were thawed quickly in front of the individual gates, but to thaw 119 of them took a crew of six men working continuously more than 36 hours. This practically meant thawing a continuous slot over two-thirds of a mile long. Hence this way of relieving ice pressure could be considered as a practical method only in an emergency, but it relieved the serious situation. Immediately thereafter a set of experiments was started to discover the feasibility of using air to keep ice from forming in front of the gates, the idea being to discharge air under water at the middle of each spillway, so that the circulation would keep the water open in front of the middle of each gate.

SURPRISING EFFECT OF THE AIR

The tests were made on ice ranging from 10 to 22 in. thick. The work which a very small amount of air could accomplish when discharged under a considerable depth of water was surprising. The explanation of this action

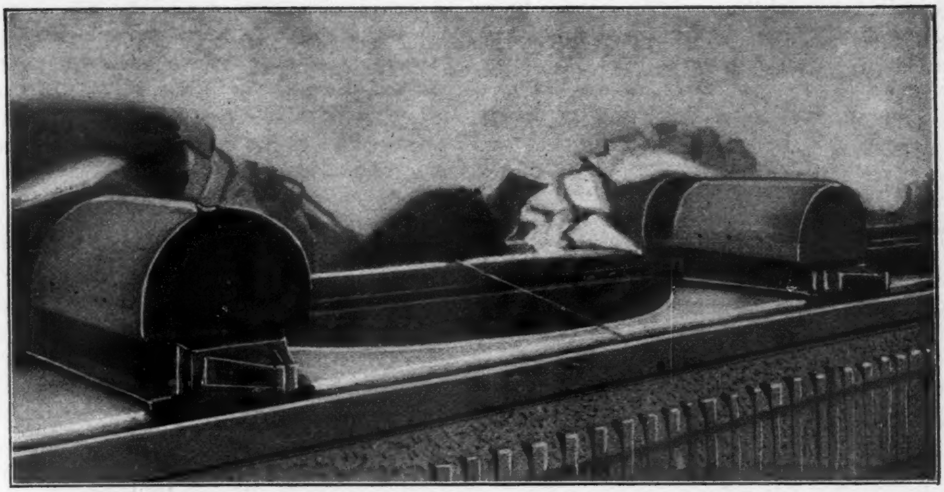


FIG. 2. LOOKING DOWN ON BACK OF DAM

is not that the air brings up warm water from below, but that it creates a circulation which keeps water, always at a temperature above freezing, passing continuously by the ice edges. A column of water rises with the air and flows radially from the point where the air bubbles break the water surface.

It was found that a little less than 2 cu. ft. of free air per minute would keep an area 20 ft. in diameter open at an air temperature of O° F., if discharged vertically upward at 18 ft. depth in a period of about four days. It was also found that for temperatures below freezing the amount of melting was directly proportional to the depth of the air, and that a change of air temperature changed the open water area by roughly 3% per degree F. over the ordinary range of freezing temperatures. An orifice calibrated to gage pressure was used to measure flow of air during the tests.

These tests proved so satisfactory that a complete system was designed to carry out the idea as evolved. The system had a sufficient capacity to furnish a maximum of 2 cu. ft. per minute of free air to each gate. The compressor was selected with sufficient capacity to supply the maximum demand on the dam, and in addition to furnish as much air again for use in the power house. This installation was completed and ready for operation a few days after the lake froze over in early December, 1917. Its total cost was well within the estimate of $9500. The installation is described as follows:

The pipe main is 2 in. in diameter from the power house east for a distance of three-fifths of the length of the dam, and 1½ in. from that point to the last spillway. It was designed by Johnson's formula to carry 2 cu. ft. of free air per minute to each of the 119 spillways with an initial air pressure of 80 lb., and a terminal pressure of 55 lb. Actual losses in operation have checked in general the computed values. Six expansion joints with a total travel of 90 in. are provided for the total length of the main, which is 4270 ft. An anchorage is placed half way between the expansion joints.

Probably the most important feature of the layout of equipment is the method employed to dry the air supplied to the outdoor system. As known, moisture in air lines out of doors is a fruitful source of trouble during cold weather. With this system especially it would be serious, because any stoppage in the air would allow water to freeze quickly in the discharge pipes where they enter the water. To get the system at work again all of the frozen discharge pipes would have to be removed and thawed individually. To dry the air an aftercooler, capable of removing two-thirds of the moisture-content of the air passing through it, was installed in the pipe line just before it passed out of doors. It cools the entering air by cold water coils and removes the moisture by condensation.

As a further aid in drying the air, the system was designed to reduce the air pressure from 125 lb. to about 75 lb. gage through a

pressure regulating valve. The resultant cooling of the air causes further condensation and drying. To date, however, this regulating valve has not been operated as an agent in drying the air, but has been operated to secure variable pressures in the main on the dam as an aid in adjusting the whole system to climatic changes, it having been found that the after-cooler dried the air sufficiently to prevent freezing in the most severe weather.

A ⅜-in. needle point valve at each spillway controls the flow of air through the ⅜-in. pipes which discharge the air. As the system has finally been laid out these are set so that they discharge vertically upward about 1 ft. in front of each gate and normally at a water depth of 10 ft. This produces a semicircular area of open water in front of the gate. It was found that the air when discharged at 18 ft. depth was too effective for convenient regulation by the small valves.

The motor driven compressor which furnishes the air for the system is a two stage machine, with air cylinders 17 and 10 in. diameter with a stroke of 12 in. and a free air displacement of 570 cu. ft. per minute at 181 revolutions. It has double the capacity that should ever be required for the dam.

The open water areas have been at all times under the easy control of the small needle valves at the top. These valves seldom need adjustment more than once a week, since a great deal of the regulation can be handled by the pressure regulating valve in the power house. An inspection is made every day or two in the severest weather to make sure that all pipes are working. The expense of labor for maintenance of the entire system for the winter will be less than $150.44.

The installation through the extremely severe weather of 1918 was most successful. The views show the conditions early in this year. There had been a movement of about a foot toward the main field of the dam, and ice had commenced breaking up at the piers. The gate is free from any pressure, as a consequence, on account of the open water area at the center. A bearing is kept against the dam, centering on the pier. Ice formed during January last to a maximum thickness of 25 in. in the open lake, and the results shown in the views have been obtained by the use of about 1 cu. ft. of free air per minute. The maximum capacity of the system has proved sufficient to melt ice from the face of the ice field faster than it can move toward the dam under ordinary expansion. Since the system was thoroughly in operation there has not been a single stoppage in the pipe main or the individual pipes due to freezing, and the system has passed through the most severe conditions that it will ever experience.

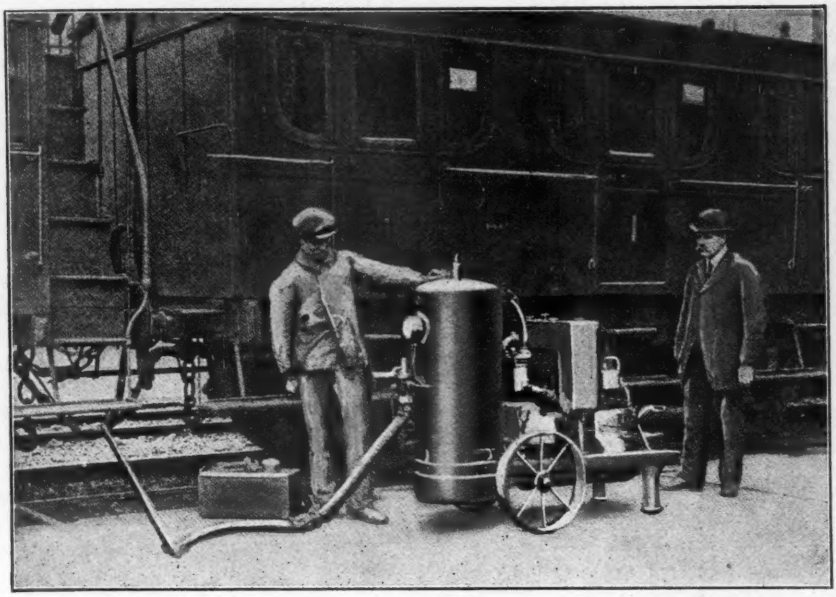
VOMITING GAS

Chloropicrin (Vomiting Gas) was prepared by Sthenhouse as early as 1848. The method he employed was to treat a solution of picric acid with bleaching powder; and, while there are a number of other ways of preparing it, this original method is the one used in preparing it on a large scale.

Chloropicrin, like many of the other so-called war gases, is a high boiling liquid. It is generally used in mixtures with other "gases," and, because of its high boiling point it is nearly always used in artillery shells or bombs. It penetrates the masks and respirators more readily than most other gases and produces nausea or vomiting, thus forcing the removal of the masks. It is an active lachrymator and is used for this effect also. There are records of it having been combined with chlorine and used in cloud attacks. It is a violent poison, in high concentrations it causes blindness, and in extremely slight concentrations it is very painful in its effect on the eyes.

In direct contact it produces painful, slow-healing burns, and deep abscesses. It is an exceedingly stable substance being only slightly attacked by water, chlorinating agents, soda-lime and many other active chemical reagents. It is this property which makes it so difficult to absorb in the mask; in fact, it is only mechanically absorbed by the charcoal in the mask, and is not affected by the chemicals at all. It is a remarkable fact that such a chemically inert substance should be so toxic. Most substances gain this property by virtue of their great avidity.

Its high boiling point makes it a valuable substance to scatter about since it soaks into the ground and persists for a long time. On the other hand it is volatile enough to keep the strata of air above it thoroughly poisoned. It has been used by both the Germans and the Allies. At the present time the United States probably is producing more than any other country.



FOR TESTING TRAIN BRAKES

PORTABLE RIG FOR TESTING TRAIN BRAKES

A French inventor, M. Campagne, has just constructed an apparatus, a view of which is here reproduced from the *Scientific American,* for testing the entire brake apparatus of made-up trains. The arrangement comprises a motor and an air compressor mounted on a hand truck. As the view shows the motor is a vertical one, of automobile type. It is of one cylinder, water-cooled, developing five horsepower; the bore is 3.6 inches, the stroke about 4 inches, and the maximum speed 1,200 revolutions per second. The compressor is geared down from the motor to operate at a speed of 650 revolutions. Motor and compressor are supplied with fuel from a common reservoir, and employ a single radiator. All parts which can possibly be made so are interchangeable, so that there is little or no probability of the assembly being put out of commission for any length of time by a breakdown.

The French railroads which have tried out M. Campagne's apparatus report that with it, one man can test all the brake connections of a train in a half hour, instead of twice that time, as formerly; and the tests can be conducted in the absence of an engineman, which was not the case when the several connections had to be brought opposite a stationary compressor. The device has been adopted by the State Railroads, as well as by the Orleans and the Eastern lines.

HOME LIFE AT THREE MINES

A recent bulletin of the School of Mines and Metallurgy, University of Missouri, comprises an advisable address by James Furman Kemp, Professor of Geology, Columbia University, entitled "The Human Side of Mining Engineering." The following is a little sample of the address.

Mining and metallurgical enterprises in a large proportion of cases differ from other industries. They are often in remote places. The community is built up around the mine or group of mines or around the smelter. The manager must not only employ and pay, but house, feed and educate. Let me give you one of two illustrations, not necessarily drawn from America. When the International Geological Congress of 1910 was held in Stockholm, Sweden, an excursion was given the delegates far to the north to the great iron mines at Kirunavaara, situated over a hundred miles north of the polar circle in Swedish Lapland. At Kirunavaara—under the leadership of Dr. Hjalmar Lundbohn, formerly of the Geological Survey of Sweden—a huge sheet shaped mass of magnetite had been

developed, that is very nearly if not quite the largest single body of iron ore yet discovered the world over. A remoter situation could hardly be conceived, nor, in winter, severer climatic conditions. From a great though somewhat diversified plain there rises to a height of some hundreds of feet the ridge whose backbone for several miles is the great sheet of iron ore, lying with a dip of 70 degrees between other sheets of contrasted eruptive rock. At the foot of the ridge in 1910 a community of five thousand souls had been established. There were a thousand children in the schools, and the school-houses in which the eight or ten score excursionists were fed were beautifully constructed and equipped. The houses of the workers were comfortable and convenient so that to the most superficial observer it was evident that Dr. Lundbohm had been moved by an almost pastoral care of his flock.

On the day on which we were conducted along a amile or more of the outcropping ore and while the other members of the party were busy collecting from the ore, the hanging wall and footwall, I sat for a brief space apart by myself and studied over the Arctic expanse of stunted trees, moraines, swamps and lakes. But continually my thoughts would come back to those five thousand people, men, women and children, all drawing their support from the mine. There they were, placed right in the hand of the General Manager, and his opportunity as well as his responsibility for more than food and clothing were very great. There was a little, organized state in miniature, and much more than Swedish kroner in dividends was involved in the way their lives were directed.

Let me ask you to turn your eyes next to the West for two more illustrations. The flourishing little city of Anaconda, Montana, gathers around the Washoe Smelter, or as the company now officially calls it, smeltery. You could not be a half-hour in Anaconda without hearing the name of E. P. Mathewson, until recently the manager of the works, and now moved by the exigencies of the war and his Canadian citizenship to develop a new company for the production of nickel in the Sudbury district, Ontario. But Anaconda is Mr. Mathewson's masterpiece—and we see not alone a great and thoroughly organized smelting plant, but good homes, good roads, a park, a fish-hatchery, and a hundred other signs of wise and far-sighted management. One also finds a singularly devoted staff of workers, reaching into the thousands and animated by one spirit of loyalty. We understand why the Mining and Metallurgical Society of America awarded its gold medal to him in 1917. Mr. Mathewson passed on to his successor not alone the management of the great works but responsibilities not unlike those of bishop of a diocese.

Were you to go farther west to the valley of the South Fork of the Coeur d'Alene river, deep down between the mountain ridges of Idaho, you would find the trim little town of Kellogg, centering about the mines, mill and smelter of the Bunker Hill & Sullivan Company. Homes for the workers with a plot of ground, which can be bought from the company under favorable terms, are the striking feature to a visitor. Instead of the slovenly cabins, and unattractive boarding houses so often the rule in western mining camps, one notes comfortable homes with little gardens in which a miner and his family may take pride. In these as well as in other ways in connection with this mining enterprise, the wisdom of Mr. Stanley Easton's far-sighted management becomes impressed on an observer.

DRAINING AIR PIPING FOR PNEUMATIC TOOLS*

It is the object of this communication to call attention to the importance of providing for effectually separating and draining the water of condensation from the piping system of pneumatic tools.

The slugs of water frequently coming through the pipes, in the general run of plants, not only interfere with the momentary operation of tools, but cut out the valves, cylinders, and wash out the oil, seriously interfering with lubrication. The water cannot be properly taken care of merely by placing drain cocks on low points in the ordinary piping system, but should be removed by special separation tanks or chambers located at these points and near the distributing manifolds. The separators will also serve as collectors of scale and dirt coming through the pipes, and the

*Standard Practice Bulletin, Emergency Fleet Corporation.

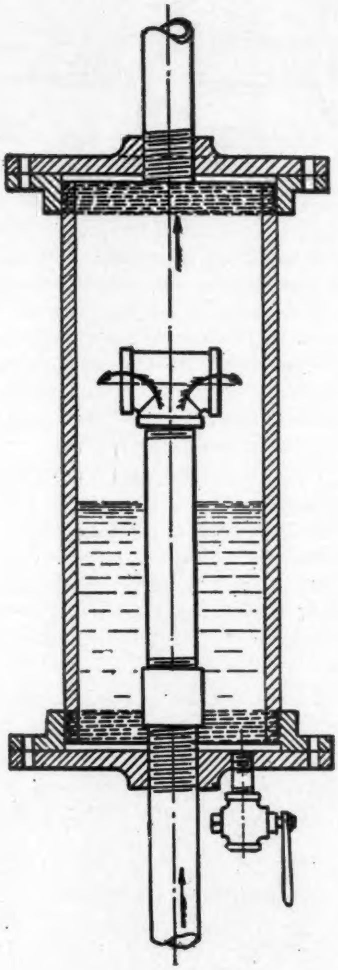


FIG. I

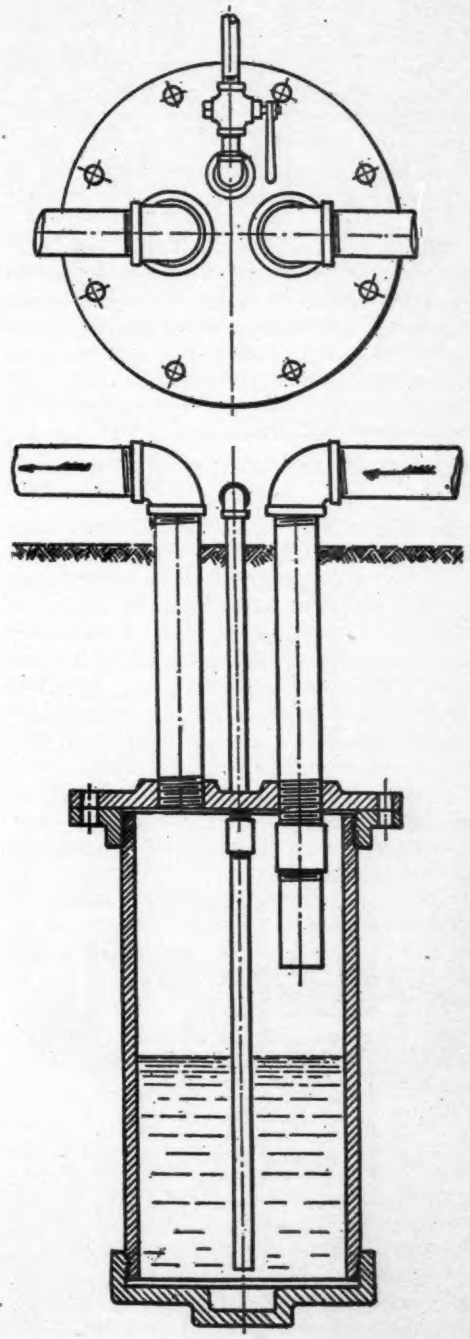


FIG. 2

drain or blow-out valves should be large enough to discharge these matters as well as the water.

The separating chambers should be large enough to lower the velocity of the air to a point where entrained water or dirt will not be carried through with the air current, and should be fitted with bafflers or connections which will change the direction of flow, so as to precipitate the entrained matter.

While the arrangement of separators will necessarily be governed by the piping layout in each individual installation, the accompanying cuts, Fig. 1 and Fig. 2, illustrate two types, which in the smaller sizes can readily be made up of standard pipe fittings. Fig. 1 shows a type suitable for vertical risers at the ship

staging, while Fig. 2 indicates a type suitable for horizontal distributing lines.

An air piping system should be uniformly graded with the direction of flow, so far as the main runs are concerned, and should always have separators at or near rising points. Sags or pockets without separators for the accumulation of water should never be permitted.

Where it is possible to do so, separators on outdoor lines should be placed in the ground below the frost line, to prevent freezing, as shown by Fig. 2. The condensation can be blown out through a vertical discharge pipe by the pressure of the air in the separator.

EUROPEAN BURNERS FOR PITCH AND TAR

In the processes of gas manufacture considerable quantities of tar and pitch are recovered as by-products. Under proper conditions these can be burned directly under the boilers or under the retorts as fuel. The combustion of these fuels is made possible through finely dividing by spraying through the use of special burners. One of these European burners is known under the trade name of "Omega." These burners enable the combustion of petrol and of heavy oil fuels, but also of such combustibles as crude tar and the soft pitch. Fig. 1 gives an idea of the principles embodied in the "Omega" burners.

The fuel reaches the combustion chamber in

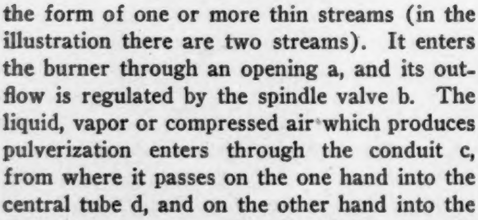


FIG. 1. SECTION OF OMEGA BURNER

the form of one or more thin streams (in the illustration there are two streams). It enters the burner through an opening a, and its outflow is regulated by the spindle valve b. The liquid, vapor or compressed air which produces pulverization enters through the conduit c, from where it passes on the one hand into the central tube d, and on the other hand into the ring-shaped space e. The liquid flows out in the form of two cylindrical layers, separated

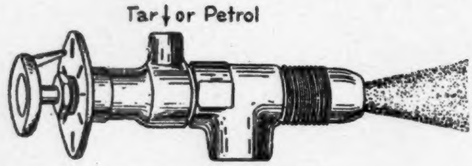


FIG. 2. OMEGA BURNER TYPE I

by the wall f. The liquid or air used for pulverizing or for forming the fuel spray is introduced into each of the fuel layers by orifices pierced obliquely in the walls of the burner. Besides, the liquid layers are divided into still finer layers or sprays by the use of the ribs i and j. The Omega burners are constructed in four different forms, two each, however, based on the same principle.

The burners using low pressure, working with the aid of compressed air below 25 cm. (9.75 in.) water column, requiring about 1500 liters (45 cu. ft.) air per liter (0.03 cu. ft.) of pulverized petrol. For crude tar or hard pitch the pressure is near 80 cm. (31.20 in.) water column and the quantity of air for pulverizing this fuel is about 3000 liters (90 cu. ft.) per liter of pulverized fuel. The rest of the air needed for combustion is drawn in by the burner with the aid of a split tube which is attached to it or by means of an air valve (Fig. 2).

Another type of low pressure burner also using compressed air (Fig. 3) uses compressed air below 25 cm. (9.75 in.) water column; these burners use about 10-12 cbm. (353-423.6 cu. ft.) air per liter of the fuel. In order to pulverize tar or hard pitch this type of burner requires about 50 cm. (19.5 in.) water column pressure. These burners are provided with a double valve system, which governs the air supply. For each position the burners work without excess of air.

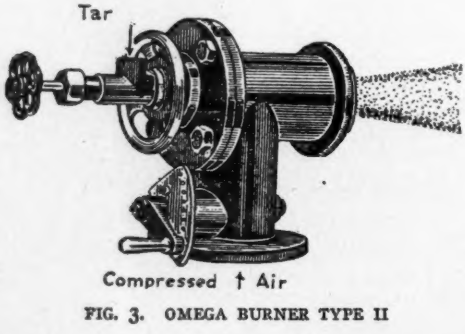


FIG. 3. OMEGA BURNER TYPE II

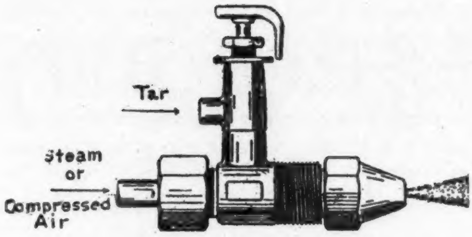


FIG. 5. OMEGA BURNER TYPE IV

The burners shown in Fig. 4 work either with steam under pressure or with compressed air, somewhat analogous to the steam jet vaporizers. They draw in the fuel by themselves and can be used to work with ½ atm. of pressure. They consume about 0.3 kg. (0.66 lbs.) of steam or 600 liters (18 cu. ft.) of compressed air per liter of pulverized fuel.

The burners shown in Fig. 5 work either with gas, with air or with steam compressed to 1.5 or more atmospheres. They consume about 100 liters (3 cu. ft.) of gas under pressure per liter of pulverized fuel. The fuel must be supplied to these burners under fairly high pressure, usually between 1.5 and higher atmospheres.

The two important applications that interest us in the question which we are considering are:

1. The possibility of using Omega burners for direct burning of tar under boilers. 2. The possibility of using these burners for direct use of tar or pitch as fuel under retorts in gas works. These burners can be used for heating either boilers or gas works retorts, locomotives or steam vessels. They have been used in several large Swiss and French plants with great success, not only from the standpoint of economy, but also from that of good functioning. They allow the utilization of sluggish fuels, such as tar and pitch represent, with a maximum caloric power and without danger of interruption of operation through mishaps or clogging of burners. Tests carried out for a long period of time by the Sulzer plants at Winterthur in Switzerland and by the gas works at Geneva have shown the practicability of this operation and the economy as well as the freedom from accidents when using this type of fuel in these burners.

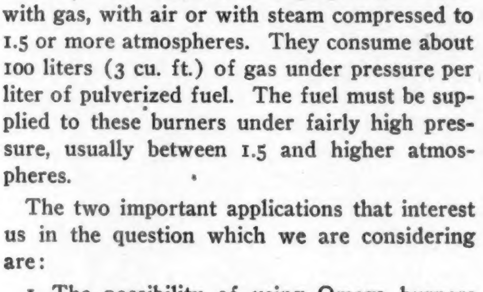


FIG. 4. OMEGA BURNER TYPE III

Lighting of the burners, if no other kind of gas is at disposal, can be accomplished by means of some compressed gas like hydrogen, passed to the furnace room from steel cylinders. Or else compressed air can also be used, furnished by a small compressor, and this can furnish the needed air pressure for further operation of the burners, once they have been lighted.

For heating the retorts in gas works the illuminating gas produced in the gas works can be used as a heating medium for the burners. This gas can be compressed to three or four atmospheres by a special small compressor. As in this case the consumption is only about 100 liters (3 cu. ft.) gas per liter of pulverized fuel, operation is very economical. During tests made at the Zurich gas works in Switzerland with Omega burners for heating of a large superheater, it was found that pitch could be substituted with great economy for the tarry oils that had been used previously for this purpose. Care must be taken that the temperature of the compressed air used in the burners for pulverization is higher than the fusion temperature of the pitch. It was observed that melted pitch is fully as fluid and mobile as the tar at the temperatures at which it is ordinarily used for fuel.

These Omega burners are being welcomed for the direct burning of pitch and tar, especially if we are going to follow a policy of utilization of by-products to as full an extent as was pointed out before. It seems a good plan to recover every possible by-product that can be recovered from the oils that possess such by-products and not use these as fuels. The coke ought to be kept separate as fuel and likewise the tar and pitch, especially the latter, and the other oils ought to be treated for their by-products to the fullest extent. Up to now pitch has not been fully appreciated as to its fuel value by gas works, witness of which

is the fact that it has been used to most part for such things as macadamizing of roads, making of roofing paper, electrodes, briquets, etc. It is obvious that the possibility of using it under furnaces and retorts as fuel is of such an economic advantage, that its use for the other purposes will be more and more restricted.

Manganese acts as a catalyst in the fixation of atmospheric nitrogen by plants through the aid of bacteria. Tests by A. de G. Rocasolano show that the nitrogen-fixing bacteria, grown in pure culture, do not fix nitrogen when manganese is absent. The highest amount of fixed nitrogen is obtained when 0.006% of Mn. in available form is present.

HEROES UNSEEN

by Frank Dorrance Hopley

The power that turns the night to day,
That drives the wheels in workshops gray,
And brings the ships into the bay,
  Is wrought by human hands.
In stifling rooms, away from sight,
Amid the dirt, from morn till night,
Men stoop to labor with their might,
  Fulfilling all demands.

The fireman and the engineer
On ocean vessels, without fear,
Beneath the decks, though foes are near,
  Work calmly every day;
They brave the submarine's quick blow,
Which oft brings death to those below;
There is no honor we bestow
  Too great for such as they.

They sweat and grind, fall ill and die,
And others come, as time goes by,
To labor on, without a sigh,
  Parts of a great machine.
No cheers are theirs, no flags are flung,
Their splendid courage is unsung,
Their names are not on every tongue,
  These men who work unseen.

We laud the soldier as he stands
On battlefields in foreign lands,
The sailor, who, within his hands
  Our safety holds this hour;
But as we sing our hymns of praise,
We'll not forget those who always
Work on, afar from human gaze—
  The men who make the power.

—*Power.*

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - Editor
FRANK RICHARDS, - Managing Editor
CHAS. A. HIRSCHBERG, - Business Manager
W. C. LAROS, - - Circulation Manager

PUBLISHED MONTHLY BY THE

Compressed Air Magazine Company

Easton, Pa.

New York Office—11 Broadway.
London Office—165 Queen Victoria Street.

Subscription, including postage, United States and Mexico, $1.00 a year. Canada and abroad, $1.50 a year. Single copies, 10 cents.

Those who fail to receive papers promptly will please notify us at once.

Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

Vol. XXIII. December, 1918. No. 12

CONTENTS

APPRECIATION

We feel that we owe the United States an apology for the false impression that has prevailed in certain quarters here as to America's aims and objects at this particular time—an impression which recent events has blown to the four winds of Heaven. Many of us had thought that America was so intent on making money out of the war that she would never rise above sordid ideas, and that her part in the struggle would be confined to protests without logical conclusions and Notes without acts. Those who entertained such notions in the early part of the war do not do so now. America, led by her noble President, who will rank hereafter with Washington and Lincoln, has risen to the full height of her great opportunity, and responded to her noblest impulses. Casting every thought of self on one side, and inspired only by the interests of justice and humanity, she has thrown herself into this ghastly war with an abandon which has hardly ever been equalled and perhaps never excelled. Some of us did not know America in the old days; we know America now. The New World has indeed stepped in to redress the balance of the old, and history will tell how much civilization and liberty have owed to the greatness of America's sacrifice and the splendour of her achievements.—*Mining World,* London.

AN ENDING AND A BEGINNING

The above was published in England a month before the Armistice so suddenly put an end to the World War, and, in fact, it was in type for our own page before that event. It needs not to be said that the status thus accorded our nation and its honored head was by the outcome of the fighting decisively confirmed. We have not only received a distinguished service badge but have been promoted in rank to the front of the World Nations.

The end which was reached by the crushing of the foul aggressor and the overwhelming of his pirate crew was complete enough. There

was an absolute finish of things as they were; but there was at the same time a beginning, and for none more than for America, of a new order of things. To-day it were only a reckless prophet who could hope to keep pace with the events which now crowd the record. We only know that none but the optimist can have a chance.

We may assume to be assured of world peace for a generation, but not a peace for the folding of the hands or for comfortable dozing. There must be a slight pause for us to catch our breath and to recover from the sharp fatigue of the moment, but then must come a more strenuous life and a fierce joy in planning and achieving. We may not take up our life activities and our productive industries where we left off, for while things left undone have accumulated, new things that belong to a larger life have shaped themselves for the doing.

The minor details of readjustment entailed by the complete resumption of the ways of peace will be little helped by any anxious contriving, and must soon and automatically adjust themselves. There will be place for every returning soldier practically at once, and not only will there be work enough for all but we will be inviting and welcoming hordes of immigrants to take the heavier burdens to which their backs will be more accustomed. The period of high wages will have left its mark in the living habits of the people, so that all will be expecting and appropriating more of the good things of life, and thus we will have been developing our own customers and enlarging our markets at home.

While the unfortunate nations of the Old World will be recovering and recuperating we will be growing and expanding. Our need of foreign products will have been reduced by the development of our own facilities which the war has compelled, and thus in the directions of both supply and demand we must learn more and more what independence is. It is with no disposition to boast or to provoke envy or jealousy anywhere that this view is presented, but simply to call attention to the facts as they are. We are not beyond the possibilities of great internal troubles of our own, but these we may hope to happily solve when they come upon us.

Take a mailing tube, say, 18 inches long and two inches diameter. Put your mouth at one end and blow through it and feel the effect of the blast on your hand at the other end. Now hold the tube about an inch from your mouth and blow into the end of the tube. You will be surprised to feel the increase of the effect at the other end.

The shock of exploding gunpowder will not detonate gun-cotton, picric acid, T.N.T., or nitro-glycerine. The shock of detonating nitro-glycerine will not detonate gun-cotton. The shock of detonating gun-cotton will detonate nitro-glycerine. Gunpowder is incapable of detonation. Fulminate of mercury will detonate all the above, with the exception of T.N.T. cast into slabs, but with the addition of a little lead azide will detonate them fully. Increasing the quantity of the initiator of detonation above a certain minimum has little effect. One gramme of fulminate will detonate an unlimited amount of picric acid. No amount of gunpowder would do it. A fulminate detonator provides combined shock and sudden heating, and is, therefore, very effective.

NEW BOOK

The A. B. C. of Aviation, by Captain Victor W. Page, Sig. R. C., A. S., 286 pages, 5½ by 8½ in., 130 illustrations. Norman W. Henley Co., New York. $2.50.

This is a most timely book, for it may well be believed that we are only at the beginning of practical aerial flight either for business or pleasure, and the time is not distant when a general knowledge of aviation will be imperative. No one could have been found better qualified to prepare such a book as this and the result is most satisfactory. All types of aircraft are described, their principles of operation and the modes of manipulation and control. Detailed drawings of the various types of airplanes are given, there is a full dictionary of aviation terms and the book is completely indexed.

An inventor of Paterson, N. J., has perfected a loom which will weave diagonal reinforcing threads into cloth to be used for tire fabrics, thus greatly increasing their tensile strength and at the same time preserving their flexibility.

THE PNEUMATIC TOOL AND THE WORKMAN

By FRANCIS M. BARNES, JR.*

The introduction of mechanical tools into the trades has been accompanied by numerous actual and claimed damages to their operators and also a more or less direct cause of the occurrence of new and particular diseases or the factor predisposing to the incitement of ordinary diseases in greater prevalence. Among such mechanical tools the pneumatic hammer, in comparatively recent years, has come to occupy a most important position in several lines, notably in shipbuilding and in the steel and stone industries.

Within the past two years complaints of ill effects from the use of the hammer have become prevalent although these do not seem to have originated so much with the individual user of the hammer as with labor organizations of which he is a member. It has been claimed that the use of the hammer produced in the men a diseased condition affecting the nervous system and leading even to paralysis, insanity or other form of complete incapacitation.

In view of the fact that in current medical literature no mention of such diseased condition from this causation could be found it became necessary to carry out an investigation to determine, if possible, whether such disease actually did exist, its extent and seriousness, and, if necessary, to study measures whereby its occurrence could be minimized or entirely done away with. Such a study is obviously of importance, not only to the workman, but to the operator whose interests are more broadly involved.

Recent investigations have been carried out in parts of the country where the pneumatic hammer is used in shipbuilding and in the steel industry. From reports of such investigations as are available it was not found, in any instance, that the use of the pneumatic hammer produced any deleterious effect upon the general health of the workers.

So far as this study is concerned the men using pneumatic hammers on limestone were found to be in good general health and none of the group examined showing any constitutional disease; their troubles (supposedly arising from use of the hammer) being limited to a disturbance of the function of the left hand—commonly known as "white fingers" or "dead fingers." As a general thing this condition occurs shortly after the men first go to work in the morning, or until they have "warmed up," although it also occurs during cold weather when the hands are exposed otherwise than in working.

First the little finger and ulnar side of the left hand (in right-handed men) become pale and blanched; the same area soon giving rise to tingling or numbing sensations, sometimes even to slight pain. The ring finger and part of the middle finger may also be involved in this process. By swinging the arms or rubbing the hands the condition may be made to disappear and when the hands are warmed the pallor rapidly gives place to diffuse flushing and reddening. The index finger and thumb of the right hand are occasionally affected; particularly in those workers who improperly control the exhaust by their finger or thumb.

So far as could be determined this condition of the hands constitutes the sole trouble from which the stone workers complain in so far as the pneumatic hammer is concerned. In all of the workers examined the hands were somewhat reddened and flushed, but not more than reasonably might be expected in the hands of outdoor workers. The hands were calloused to a varying degree in different subjects, but in all quite extensively. The palm and certain of the fingers of the left hand were more calloused than on the right. There was no actual cyanosis, excepting in one subject, where this was slight. No swelling, no tendernesses, no pain, no edema and no involvement of the muscles or joints. Paresthesia was absent excepting in one subject, who reported some numbness in his "white fingers." This was the only subject to show the condition well developed. Sensation for all tests was acute and practically normal. In most subjects there was a lowering of acuteness of feeling—some blunting or dulling—but this certainly was no greater than could be expected in hands where so much callous was present. In all but one subject the callous was sufficient explanation for any variation from the normal whch could be observed in sensation. In this one subject the sensory disorder passed off in a few minutes or as soon as the hands

*From a paper presented at the Safety Congress of the National Safety Council, St. Louis, Sept. 18-19.

became warm. Mental disease was not present in any subject examined, nor was there any physical disease which could in any way be attributed to the occupation.

Such disorders of the extremities indicate very clearly that a disturbance of the peripheral circulation of the blood is responsible for their occurrence. The calibre of the peripheral blood vessels, and therefore the amount of blood supplied to the part, is dependent in large measure upon the action of the nerves which supply these blood vessels, known as vasomotor nerves. Low temperatures stimulate the sensory nerve fibers in the skin and the nerve impulses thus aroused reflexly stimulate the vasoconstrictor center, or a part of it, and cause blanching of the skin. That cold may produce evident changes in the appearance of certain parts of the body, notably of the extremities—the feet, hands, ears and nose—is a matter of common observation.

It has been pointed out that exposure of the hands to cold usually produces at first a pallor of the skin which is evidently due to a constriction of the cutaneous arterioles. When the exposure is prolonged, however, the color is heightened and the skin usually becomes more or less cyanotic. Almost universally, therefore, cold produces a constriction of the cutaneous arterioles and a slow flow of blood through the skin. The variations in color are thus caused by the varying amounts of blood that collect in the skin capillaries. The flow through the blood vessels is also in part influenced by the muscles which surround them. Anything, therefore, which interferes with or impedes the normal action of the muscles will have its effect in turn upon the circulation, as it is the changing state of contraction and relaxation of the muscles which aids in the flow of blood under normal conditions. Where a group of muscles is held in a contracted state for a considerable length of time the circulation is thereby impeded.

With the workman, whether using a chisel and mallet or a pneumatic hammer, the factors of cold, continued muscle contraction and cutaneous irritation are all present to a considerable degree and demand due evaluation in the consideratoin of such disorders in the hands as are sometimes observed. The fact, borne out with uniformity in this investigation, that the trouble occurs only in cold weather indicates most conclusively that the low temperature itself is one of the most important factors in the causation. The continued muscular contraction and the mechanical irritation (vibration) may play a role in its causation, but evidently these are of secondary importance.

The fact that the trouble, when present, preeminently affects the left hand, which holds the chisel and not the hammer, indicates clearly that other factors than the hammer itself are of more signal importance in its causation. The cramped position of the chisel hand with the more or less continuously maintained contraction of the muscles is one of these important factors. However, the hammer or the grip of the chisel, either alone or combined, are not sufficient to produce the condition, as is proved by the fact that it does not occur in the warmer seasons of the year when industry is at its height. The role of the vibration is uncertain, but as the trouble occurs in the hand not holding the hammer, it is doubtful if its importance is very great. We have left, therefore, the factor of low temperature which seems to be the final and most important element in the production of those vascular changes seen in the hands of some workers which, although physiological in nature, form the pathological basis for the occurrence of "white fingers" and "dead fingers." So far as can be ascertained the condition leads to no permanent disability and results in no organic disease. Why it is that only a portion of stone cutters are affected cannot be answered. Whether certain undetermined conditions of poor general health or specific diseased condition existing, but not recognized, predisposes certain men to this disturbance is not evident from this investigation, although apparently such is not the case. With one or two exceptions they were all well developed, robust men without demonstrable general physical or mental disease.

DRAWS INTERESTING CONCLUSIONS

Conclusions drawn from a comparatively small series of observations must be subject to some limitations. However, the uniformity of the results of the examinations made in this investigation, taken together with the testimony of the workmen and of others, reasonably justifies the following deducations:

1. Structural steel workers, ship-builders and stone cutters as a class, enjoy good general health and are not, because of their trade, espe-

cially susceptible to any particular disease.

2. Stone cutters are liable to a disorder affecting the hands, especially the left hand.

3. This disorder of the hands is of a vascular character, not due to organic changes in the circulatory system, but dependent upon vasomotor reactions.

4. These reactions are physiological in character and are occasioned by three factors incident to the work of stone cutting: Mechanical irritation of the skin, continued muscular contraction of a cramping nature and low temperature.

5. Of these three factors, cold is considered the most important because the condition only occurs during the severely cold weather and never in the summer, and warmth and measures to restore the circulation (rubbing, swinging the arms and the like) cause its disappearance.

6. It cannot be caused by the effect of the air hammer alone because it occurs in those who have not used the air hammer. It does not occur in warm weather when industry is at its height and, therefore, when the air hammer is most in use. It occurs mostly in the left hand and not in the right hand in which the hammer is held.

7. The vasomotor disorder is of temporary duration and is not known to have resulted in permanent disability of the hand, nor itself to have been the cause of development of any other local or constitutional disease.

8. It is possible that once having occurred the person is rendered more susceptible to its reappearance, just as is the one who had had his ears or fingers frostbitten by the cold.

9. There is no sufficient reason in the signs and symptoms presented in this disorder to conclude that one has to do with Raynaud's disease, acroparesthesia, neuritis or an occupational neurosis.

10. The institution of measures to warm the chisel before and while using, enlarging the shank of the chisel and covering it to make it possible to hold without so cramping a grip, the wearing of gloves, and the discontinuance of the prevalent custom of blocking the exhaust outlet, and thus forcing a draft of chilled air out along the chisel and onto the fingers of the left hand would do much toward the prevention of this trouble.

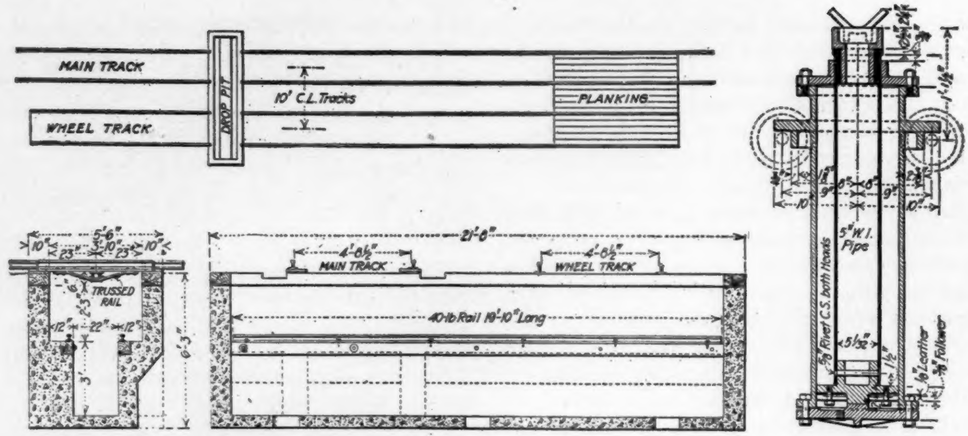
Vienna tramway conductresses are dressed from head to foot, including boots, in paper.

ARTIFICIAL SILK

Artificial silk is becoming an article of importance in the world's industries. For instance the cost of the artificial silk yarn used in the United States in 1899 was $10,380; in 1904, $1,623,000; in 1909, $1,927,000; in 1914, $3,440,000; and in 1917 presumably more than $25,000,000.

The process of turning trees into silk stockings through the transformation of wood pulp into cellulose, from which to produce the artificial silk threads, is comparatively simple. The wood pulp is treated with caustic soda to form a sodium cellulose and this is then dissolved in carbon disulphide. The product, alkali-cellulose-xanthate, is a viscous solution popularly called "viscose;" and, after being filtered and allowed to ripen by standing, it is forced through minute openings in a metal plate into a liquid which solidifies the threads, which are, when completed, similar in appearance, dimensions and chemical qualities to the fiber produced by the silk worm itself. Indeed the substitute is almost exactly identical with that carried in the body of the silk worm from which he spins the cocoon which man transforms into silk threads.

ONION CONQUEROR



AIR JACK FOR CAR WHEEL DROP PIT

By F. G. Lister*

The car wheel drop pit shown in the accompanying illustration has been in use at the various terminals of the El Paso & Southwestern System for about three years. It has proved to be a means of saving much time and expense in removing and replacing car wheels, as it does away with the necessity for jacking up the car and trucks when wheels are to be changed.

The essential features of the construction consist of a pit 3 ft. 10 in. wide by 2 ft. 9 in. deep which is bridged by two trussed rails in the track. A wheel track to facilitate the bringing of wheels to the pit and removing them for repair is located alongside the main track and the pit connects these two.

At the bottom of the pit and extending across these two tracks is another narrow-gauge track. A jack provided with wheels to support it and to facilitate its movement runs on this track. To remove a pair of wheels from a car it is only necesary to run the car across the pit until the wheels which it is desired to remove rest on the center of the trussed rails. The jack is then run underneath the car and raised to support the wheels and lift them slightly so that the trussed rails can be removed. The jack is then lowered with the wheels and run along its track until in line with the wheel track where it is again raised, and by applying the trussed rails to the wheel track the wheels can be rolled out of the way.

*Mechanical Engineer, El Paso & Southwestern System, in *Electric Railway Journal.*

A FIVE-AND-A-HALF MILE CLIMB IN AN AMERICAN AIRPLANE

It seems reasonable to suppose that the recent world's altitude record of 28,900 feet established by Capt. R. W. Schroeder, U. S. A., at Dayton, Ohio, will stand for many months to come. And so the record stands today as the achievement of an American aviator, carried by an American-built airplane, and propelled by an American-built engine.

For his record climb Captain Schroeder used a single-seater Bristol fighting plane, equipped with a 300-horse-power Hispano-Suiza engine. Caleb Bragg's previous American altitude record of 20,250 feet, made with a Wright-Martin model airplane equipped with a Hispano-Suiza engine, had stood for a year and was only eight feet under the world's record of the International Aeronautic Federation made by Lagagneux on December 13th, 1913. The Government has accepted Captain Schroeder's record as official, thereby regaining our laurels lost when Lincoln Beachey's world record of 11,642 feet made at Chicago in 1911, was subsequently beaten.

Captain Schroeder's experience is interesting. While it was a comparatively warm day on the ground, several of his fingers were frozen and in removing his goggles for an instant for adjustment, his nose was also frost bitten. The intrepid aviator used a rubber hose direct from the oxygen bottle, regulating the supply by means of a valve on the bottle. The hose was placed in his mouth so that he

could breathe air and oxygen at the same time. At intervals he pressed his tongue against the end of the hose in order to tell if the oxygen was still flowing. This method was quite satisfactory, except that the oxygen bottle and the rubber tube gathered about a quarter of an inch of frost, which made it very unpleasant. Captain Schroeder found the oxygen supply indispensable above 25,000 feet, receiving warning of this fact by a sort of drowsiness and mental depression, which were removed with the taking of oxygen. At the 29,000-foot level the temperature was recorded as 62 degrees below zero, Centigrade.

The Hispano-Suiza engine functioned perfectly throughout the ascension, and only stopped when the gasoline supply was exhausted. Captain Schroeder then volplaned down from his great height and landed at Canton, Ohio, over 200 miles from the starting point.

AIR FOR CLEANING STRUCTURAL IRON AND PAINTING

By A. E. Wilson

Painting over scale or the fine rust under the scale is labor and material wasted, as corrosion will continue as long as there is any rust under the paint. The only effective way to remove this rust is by the use of a sand blast. This method will remove all rust, dirt, etc., and leave the iron in a condition that will enable the new paint to stop further corrosion. The best outfit to use is a portable machine that is light and easily transferred in work cars and which can be set up on the job without blocking the main track or stopping trains.

In using the sand blast care should be exercised not to hold the nozzle too close or too long on the same place, as it will wear away the metal. The cost of cleaning by the sand blast varies according to the type of bridge to be cleaned, but it will average about $1 a ton, which is much cheaper than it can be done by hand.

The heavy scales of rust must be chipped off with hammers or air chisels, as the sand blast will remove them only by eating through and the men operating the nozzles are liable to go through too far and damage the iron. It is necessary to follow up the cleaning with a coat of good paint immediately, as corrosion starts very quickly after the use of the sand blast. All the surface cleaned should be painted before leaving the work at night, or it will be covered with a fine rust by the following morning.

As regards spraying of paint on bridges, personally I prefer the old fashioned way of applying a paint of medium weight with a good brush, except in places where one can not reach with a brush or swab. But in applying cold water paint or white wash on the interior of buildings or in the painting of concrete buildings I think spraying the material is the best and cheapest method. Concrete is so porous that it takes quite a little time to rub in the paint to fill up the pores, and unless you have reliable men they will skip over the outside of the surface and not fill it in, thus leaving it very uneven when finished. A portable compressor and tank for this work will pay for itself in one season if there are many concrete buildings to paint or white wash.

I would not recommend the spraying of stations or other station buildings. It is in pockets and other places that are difficult to get at with a brush, as on an I-beam bridge where the I-beams are so close together and it is impossible to get a brush or swab between them, that the sand blast and spraying machine do the best work.

In using the spraying outfit, the air pressure on the tank holding the material should not be more than is necessary to raise the material and cause it to flow slowly from the nozzle held in a working position. The air pressure at the nozzle should be just sufficient to atomize the material. The nozzle should be held about 6 in. to 10 in. from the surface of the work, and be moved back and forth with smooth and even strokes. Its operation is simple and any one with a little practice can cover a large area in a day.—*Railway Age.*

THE CAVALRY OF THE AIR

To institute a comparison between the cavalry of the land and the cavalry of the air is interesting and not altogether profitless. The air force can make no prisoners and can take no ground, much less occupy it, but it can do work which, for the cavalry, is impossible. It can go beyond enemy outposts; indicate his formations; see where he has his reserves, and what services he has in his rear. Aero-

planes can bomb the enemy on the march, in camp, and in fact everywhere and anywhere. It can destroy bridges, cut-up convoys, make roads difficult, compel the enemy to abandon enormous quantities of war material and thousands of prisoners. German aviation has been reduced almost to powerlessness. French machines now act in groups, and the mortality amongst enemy productions shows the effectiveness of the method. For example, the July 15 German offensive was perfectly known to the French. At Lassigny the enemy was bombed by 120 aeroplanes, and as these operated in relays, their work was continuous and effective. The air service did immense service in the recent battles of Champagne and Picardy, and of a kind that cavalry cannot do.

Aviators are always in the van. They prepare the way for artillery and indicate the precise spots where shots can best be placed. They also, in conjunction with the tanks, prepare the way for the infantry. When we get the mass of machines the Americans have promised, Germany may be conquered even from the air, for there is no more effective way of dealing with the Huns than by carrying the war into their own camps, towns and cities. The aeroplanes employed today are vastly different from those used at the beginning of the war. They have been immensely improved, and it would be difficult to say when perfection will be reached.—*Mining World*, London.

THE LATEST BRITISH AIRPLANES

It is stated, says the *Daily Chronicle*, that the Royal Air Force will soon have swarms of a new type of machine at the battlefront which is likely to add greatly to the difficulties of the Germans. This machine, a brilliant example of the constructor's art, is capable of carrying with its pilot and observer a great weight of bombs, machine guns, and other equipment, to over 20,000 feet, and in an extraordinary short time. Soaring, as the new machine will, above the average range of guns and German airmen, it can cross the fighting lines, drop its bombs, and return home swiftly for a new load. So fast is it, even at great altitudes, that long distances can be accomplished in the shortest periods, and bombing raids which with the older type of machine would, perhaps, need a whole day's preparation, will now be carried out within a couple of hours. Moreover, what is of the utmost importance, their engines are completely reliable, and the risk that they might fail when a hundred miles over the enemy lines—a risk too common with some of the earlier types—no longer exists. It says much for their supreme value that, so far, not one of this type has been brought down, in spite of the Hun's utmost efforts. When the weather will not permit high flying, as is often the case in the winter, these machines will fly low, and so great is their speed that all but the very fastest of modern scouting planes will be left behind them. For these machines the unmost skill and nerve are needed. The observer must not only be able to ward off hostile craft by accurate machine gun fire, but he must also have an expert knowledge of map-reading and aerial navigation, since when flying long distances at great heights it is extremely difficult to find one's way by any landmark.

Of a world's copper production of approximately 3,100,000,000 pounds in 1917 the refineries of the United States produced 2,262,000,000 pounds, or a trifle less than 80 per cent.

A firebrick cement, for which saving in time of laying the bricks and long life of the joints are claimed, has been placed on the market under the trade name of "amalgam." The bricks are merely dipped in the cement. This does away with the usual buttering or covering of the bricks before they are laid. When used as a lining it is claimed that the covering of the lining bricks with the cement results in an increased life of the brick.

According to information received from one of the leading East coast shipyards, says *Marine Engineering*, the best day's work on a shell with pneumatic riveting is 700 rivets of ⅞-in. diameter, and for hand work, under the same conditions, 430. An average day's work is considerably less than this, and may be taken as being 510 rivets with pneumatic riveters against 264 with a hand squad, for work on all parts of one ship.

In a recent discussion of the cost of oxy-acetylene welding at a meeting of steam railroad mechanical men some data were given to show that the average cost of welding by this process is about $1 per cubic inch of weld. The data covered welds using from 1½ lb. to

2¾ lb. of welding metal, with acetylene at 3 cents per pound, oxygen at 14 cents per hundredweight, welding metal at 10 cents per pound and labor at 42 cents per hour.

A new fruit containing a large percentage of oil has been discovered in the region of Torreon, and is known by the name of "chichopoxtle." Experiments show that 25 per cent. of its contents consist of oil of great value in industrial pursuits requiring a lubricant of high quality.

The United States Fuel Administration is desirous of securing catalogues of dealers in power-plant accessories. Publications of this kind should be addressed to David Moffat Myers, Advisory Engineer, United States Fuel Administration, Washington, D. C.

A Royal warrant announced that the Continental system of time—the 24-hour clock—would be brought into use throughout the British Army from midnight, September 30th-October 1st, 1918. The "time of origin,' that is, the time at which a message or dispatch is signed by the originator, will always be represented by four figures, the first two figures, 01 to 23, representing the hours from midnight to midnight, and the second two fingers, 01 to 59, representing the minutes of the hour.

Tungsten has the highest melting point of all known metals, namely 3350° C.; it is one of the hardest of the metals; it has the highest equiaxing, or recrystallization temperature after strain hardening, of all pure metals known. It is particularly distinguished because, when composed of small equiaxed grains, it is extremely brittle and fragile at room temperature, and when possessing a fibrous structure it may be ductile and pliable at room temperature. The common ductile metals act in exactly the opposite manner in this respect.

An ordinary potato may be used to tell which is the positive and which is the negative terminal of a circuit. Insert the two current-carrying wires into the freshly-cut surface. A green stain, due to dissolved copper, indicates the positive wire. If both wirese are surrounded by dark colored stains the current is alternating. If you haven't a potato handy, place both terminals in water. Bubbles will collect at the end of the negative wire. If the water is in a metal vessel be very careful not to let the wire touch the metal or a short circuit will be formed.

The method of awakening a heavy sleeper by sprinkling cold water on the face is one with which we were all more or less familiar in our youthful days. Usually, it is harmless and effective, but it has been attended with tragic results recently on a well-known goldfield. An oiler employed in the cyanide works was indulging in a siesta at a time when he should have been attending to his duties. It appears his foreman thereupon threw some water which was in a bucket in the room over his face, with the intention of arousing him. The boy woke up but was unable to walk and shortly after took ill and began to bleed at the nose. The foreman tried to bring him round but failed and ordered him to be sent to the hospital. While he was being taken away he died. It has been ascertained that the liquid in the bucket was not pure water, but contained some cyanide solution which is used at the works, and it is surmised that the deceased swallowed some of the stuff.

It is a well-known fact that at a height of 1 ft. from the water an object can be seen at 1.32 miles; at 6 ft. elevation the range of vision is increased to 3.23 miles, while at 10 ft. the horizon is increased to 4.16 miles. This in clear weather puts great limitations upon the sight of a submarine periscope, as, all allied merchant vessels are keenly on the lookout for such, says *Marine Engineering and Naval Architect*. From the above it is also very evident that aircraft have extraordinary value in scouting for submarines, as at 25 ft. elevation an object can be seen 6.59 miles away; at 100 ft., the range of vision is increased to 13.17 miles; at 500 ft., the line where sea and sky meet is 29.45 miles away. At a mile high an aeroplane has a range of vision of 95.7 miles. At this height, with powerful telescopes, an aircraft can sweep an area of about 300 miles. In order to distinguish the camouflaged vessels of the Allies, the Germans have fitted their latest periscopes with ray filters, which clearly bring out the outlines of such otherwise invisible vessels.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

SEPTEMBER 10.

1,278,127. EVAPORATING APPARATUS. John H. Fedeler, New York, N. Y.
1,278,222. VACUUM-CLEANER NOZZLE. Lynn D. Rudolph, Chicago, Ill.
1,278,237. EXHAUST-CONTROLLING VALVE FOR PERCUSSIVE TOOLS. Fred M. Slater, Easton, Pa.
1,278,314. FLUID-PRESSURE GENERATOR FOR TURBINES. Arthur Dix, Santa Maria, Cal.

1. In a fluid pressure generator, a generating chamber, means for delivering water thereto in a cone-shaped film, means for delivering air into the chamber through the apex of the water film, and means for discharging fluid fuel in a cone-shaped spray through the apex of the water film.

1,278,317. AIR-BRAKE SYSTEM. Frank H. Dukesmith, Meadville, Pa.
1,278,350. SHOCK-ABSORBER. Cecil A. Hubbard, Ann Arbor, Mich.
1,278,387. TIRE - CHARGING AIR - PUMP. Loren Risk, Minneapolis, Minn.
1,278,391. PULSATOR FOR MILKING-MAchines. Edward Schlukebier, St. Paul, Minn.
1,278,524. FLUID-PRESSURE BRAKE APPARATUS. Walter V. Turner, Edgewood, Pa.
1,278,572. AIR AND GAS PUMP. Richard A. Bemis, San Bernardino, Cal.
1,278,593. DRYING AND AERATING MACHINE. Charles Edwin Clark, William Moore Clark, and Jonas A. Sparks, Elk City, Kans.
1,278,620. LIQUID-FUEL BURNER. Thomas B. Ferguston, Brooklyn, N. Y.
1,278,627. FLUID-PRESSURE STABILIZER FOR AEROPLANES. George A. Fowler, Jr., Thatcher, Ariz.
1,278,657. PNEUMATIC LUBRICATING SYSTEM FOR LUBRICATING THE FLANGES OF TRACK VEHICLE-WHEELS. Charles Frederick Hoofer, Seattle, Wash.
1,278,700. ROTARY COMPRESSOR AND VACUUM-PUMP. George C. McFarlane, Denver, Colo.
1,278,772. SHOCK-ABSORBING ARRANGEMENT FOR VEHICLES. Jean Paul Sinsou, Levallois-Perret, France.

SEPTEMBER 17.

1,279,067. APPARATUS FOR GRADING, SEPARATING, CLEANING, AND CLIPPING GRAIN. John W. Wright, Battleford, Saskatchewan, Canada.
1,279,085. ENGINE-DRIVEN AIR SYSTEM FOR DIESEL ENGINES. Gregory Caldwell Davison, New London, Conn.
1,279,115-6. VACUUM-FUEL-FEED SYSTEM. Webb Jay, Chicago, Ill.
1,279,308. CEREAL-GRAIN-HULLING SYSTEM. Frank Emenegger and Joel H. Westfall, Petaluma, Cal.
1,279,363. ELECTRICAL AIR-HEATER. Frank Kuhn and Jay A. Hand, Detroit, Mich.
1,279,379. VACUUM PROCESS FOR PRESERVING AND OTHER PURPOSES. William Steven Sellars, Brooklyn, N. Y.
1,279,388. PNEUMATIC TENSION-REGULATOR FOR AUTOMATIC MUSICAL INSTRUMENTS. Louis H. Maier, New York, N. Y.
1,279,460. AIR MOISTENING AND COOLING DEVICE. Samuel Shoesmith, London, Ontario, Canada.

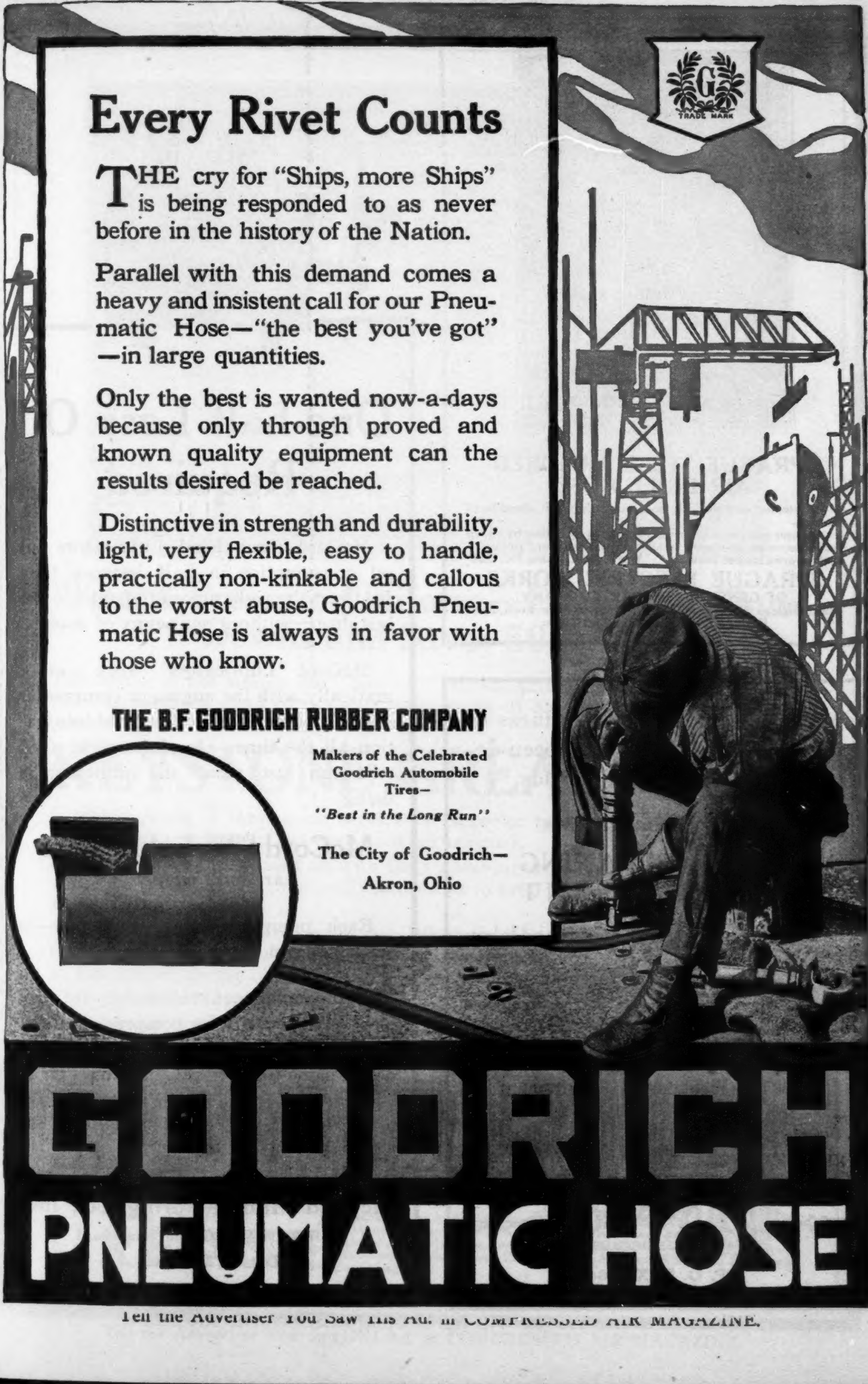
SEPTEMBER 24.

1,279,536. AIR-BLAST OIL-STOVE. Alvah M. Griffin, Kansas City, Mo.
1,279,558. LIQUID - LIFT. Frank Edward Lichtenthaeler, Newton Highlands, Mass.
1,279,580. AIR - PUMP FOR WATER-DISTRIBUTING SYSTEMS. Theodore Peters, Ferdinand, Ind.
1,279,650. DIE-CASTING MACHINE. George Waldemar Bungay, Brooklyn, N. Y.
1,279,685. AUTOMATIC AIR-CONTROLLING DEVICE FOR GAS-ENGINES. Wade H. Guthrie, Charleston, W. Va.
1,279,786. PNEUMATIC VALVE-ACTUATING DEVICE. Henry Wm. Terry and John W. Fowler, Toronto, Ontario, Canada.
1,279,823. PROCESS AND APPARATUS FOR CAUSING PRECIPITATION BY COALESCENCE OF AQUEOUS PARTICLES CONTAINED IN THE ATMOSPHERE. John Graeme Balsillie, Melbourne, Victoria, Australia.
1,279,844. NUT - MEAT - CLEANING APPARATUS. Homer L. Cole and Fern S. Bishop, Santa Ana, Cal.
1,279,859. DUPLEX AIR-PUMP FOR CARBURATING OR GAS MACHINES AND THE LIKE. Arthur Grandjean, San Diego, Cal.
1,279,925. PNEUMATIC CUE. Ezra B. Smith, Chicago, Ill.
1,279,927. AIR - BRAKE ALARM - SIGNAL. Robert D. Smith, Brookline, Mass.
1,279,929. VALVE-GEAR FOR ROCK-DRILLING. William Charles Stephens, Carn Brea, England.
1,279,933. COTTON-PICKER. Louis C. Stukenborg,, Chicago, Ill.
1,279,981. AUTOMATIC BLOWER ATTACHMENT FOR PUNCH-PRESSES. Edward Calderio, Garfield, N. J.
1,280,010. PRESSURE-CONTROLLER. Nijah I. Garrison and Harry W. Steele, El Reno, Okla.
1,280,020. VACUUM-CAP. Charles Hammer, Queens, N. Y.
1,280,063. VALVE FOR AIR-COMPRESSORS, Etc. Frank L. Miller, Parkersburg, W. Va.
1,280,101. REFRIGERATING - MACHINE. David I. Davis, Chicago, Ill.

1. In a refrigerating machine, the combination of an evaporator, a low-stage compressor, to which the evaporator discharges, for initially compressing the gaseous refrigerant, a high-stage compressor to which the low-stage compressor discharges, a condenser to which the high-stage compressor discharges and discharging to the evaporator, means for introducing refrigerant from the condenser into the line of communication between said compressors, and means for mixing said last-named refrigerant with the gas passing from the low-stage to the high-stage compressor whereby the volumetric efficiency of the high-stage compressor is increased.

OCTOBER 1.

1,280,139. GLASS MANUFACTURE. Richard H. Bolin, Rochester, N. Y.
1,280,146. AIR-NOZZLE FOR TRACK-SANDERS. Elmer E. Bradley, Clinton, Iowa.
1,280,157. COMBINED AIR AND ELECTRIC TRIPLE VALVE. William George Canion, Baltimore, Md.
1,280,229. AIR-COMPRESSOR. William H. Hutchinson, Howard Lake, Minn.
1,280,276. CENTRIFUGAL AIR - COMPRESSION SYSTEM. Robert V. Morse, Ithaca, N. Y.
1,280,332-3-4. FLUID - PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.
1,280,420. CUTTING-TORCH. Frank Y. Dibble, Chicago, Ill.
1,280,500. SPEED - CONTROLLING APPARATUS FOR RAILWAY-VEHICLES. Lloyd V. Lewis, Edgewood Borough, Pa.


Every Rivet Counts
THE cry for "Ships, more Ships" is being responded to as never before in the history of the Nation.
Parallel with this demand comes a heavy and insistent call for our Pneumatic Hose—"the best you've got"—in large quantities.
Only the best is wanted now-a-days because only through proved and known quality equipment can the results desired be reached.
Distinctive in strength and durability, light, very flexible, easy to handle, practically non-kinkable and callous to the worst abuse, Goodrich Pneumatic Hose is always in favor with those who know.
THE B.F. GOODRICH RUBBER COMPANY
Makers of the Celebrated Goodrich Automobile Tires—
"Best in the Long Run"
The City of Goodrich—Akron, Ohio
TRADE MARK
GOODRICH
PNEUMATIC HOSE

CLASSIFIED BUYERS' GUIDE

Air Cylinder Oil.
Chicago Pneumatic Tool Co.

Air Lift Pumps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Air Receivers and Reheaters.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.
Wm. B. Scaife & Sons Co.

Aftercoolers, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Stearns-Roger Mfg. Co.

Belting.
Republic Rubber Co.

Blowers.
Cameron Stm. Pump Wks. A.S.
Chicago Pneumatic Tool Co.

Blowing Engines.
Cooper Co., C. & G.
Ingersoll-Rand Co.

Catalogue Designers.
Jewett

Channelers.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Charging Stations.
Porter Co., H. K.

Coal Cutters.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Compressors, Air and Gas.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Hartford Contr's. Supply Co.
Ingersoll-Rand Co.
Powell Co., Wm.
Stearns-Roger Mfg. Co.

Compressor Fittings, Air & Gas
Chicago Pneumatic Tool Co.
Powell Co., Wm.
Republic Rubber Co.

Compressor Regulators.
Chicago Pneumatic Tool Co.

Core Drills, Diamondless.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Corliss Engines.
Cooper Co., C. & G.

Drilling Machines, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Drill Sharpeners.
Chicago Penumatic Tool Co.
Ingersoll-Rand Co.

Drill Steel, Hollow and Solid.
Inter'l High Speed Steel Co.
Ingersoll-Rand Co.

Electro-Pneumatic Machinery.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Foundry Appliances.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Son Co.

Gas Engines.
Cooper Co., C. & G.
Hartford Contr's. Supply Co.

Gaskets.
McCord Mfg. Co.

Hammer Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hammers, Calking & Chipping.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hammers, Riveting.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Hoisting Machinery.
Lidgerwood Mfg. Co.

Hoists, Air.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Hose Coupling and Clamps.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Hose, Steam and Air.
Chicago Pneumatic Tool Co.
Goodrich Rubber Co., The B.F.
Ingersoll-Rand Co.
Republic Rubber Co.
Stearns-Roger Mfg. Co.

Locomotives, Compressed Air.
Porter, Co., H. K.

Lubricating Grease.
Keystone Lubricating Co.

Lubricating Oils.
Ingersoll-Rand Co.
Keystone Lubricating Co.

Lubricators.
McCord Mfg. Co.
Powell Co., Wm.

Meters, Air.
Ingersoll-Rand Co.
New Jersey Meter Co.

Mining Machinery.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Motors, Air and Gas.
Chicago Penumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Oil Cups.
Powell Co., Wm.

Ore Concentrating Machinery.
Stearns-Roger Mfg. Co.

Photo-Engravers.
Jewett.

Pile Drivers, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Plug Drills.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Pumping Systems, Pneumatic.
Bury Compressor Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Air.
Cameron Stm. Pump Wks., A.S.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Automatic Displac'ment
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stearns-Roger Mfg. Co.

Pumps, Steam.
Cameron Stm. Pump Wks., A.S.
Stearns-Roger Mfg. Co.

Quarry Machinery.
Bury Compressor Co.
Cameron Stm. Pump Wks., A.S.
Chicago Pneumatic Tool Co.
Hartford Contr's. Supply Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Rock Drills, Air and Steam.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Rock Drill, Electric-Air.
Stearns-Roger Mfg. Co.
Ingersoll-Rand Co.

Sand Blast Machinery.
Ingersoll-Rand Co.

Sand Riddling Machines.
Chicago Pneumatic Tool Co.

Separators, Air.
Griscom-Russell Co.

Stone Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Tank, Air.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Porter Co., H. K.
Wm. B. Scaife & Sons Co.

Tools, Pneumatic.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Oldham & Sons Co., Geo.
Stearns-Roger Mfg. Co.

Unloaders.
Jarecki Mfg. Co.
Yarnall-Waring Co.

Water Traps.
Bury Compressor Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

One Member In a Family Is Not Enough

EVERY man and woman in the country, not in khaki or navy blue, should answer "present" to the Red Cross Christmas Roll Call the week of December 16-23.

A message of good cheer will be sent overseas this coming Christmas Eve, to hearten our fighting boys and our Allies.

That message must be complete—there must be no room for doubt that we stand behind them—it must bear the word that there is **Universal Membership** in the Red Cross—**their Red Cross.**

Let us make our second Christmas at war a Red Cross Christmas—with full membership in every American home.

All you need is a Heart and a Dollar.

RED CROSS CHRISTMAS ROLL CALL

DECEMBER 16-23

Contributed through Division of Advertising

U. S. Gov't Committee on Public Information

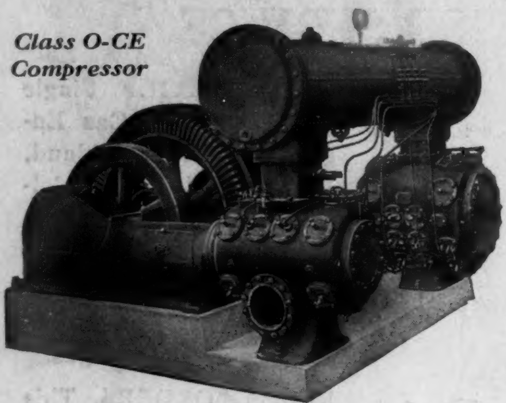
This space contributed for the Winning of the War by Ingersoll-Rand Co.

INDEX TO ADVERTISERS

Chicago Pneumatic Air Compressors

Direct Motor Driven, also Steam and Belt Driven

Class O-CE Compressor



"Chicago Pneumatic" Compressors are equipped with the Simplate Disc Value, the simplest and most efficient compressor valve yet devised, and absolutely noiseless in its operation.

The larger power driven types are equipped with our new Two or Four-Step Control—a system of automatic regulation whereby the largest compressor may be operated economically at as low as one-fourth of its capacity—an exclusive feature of "Chicago Pneumatic" Compressors.

"Chicago Pneumatic" Simplate Valve Compressors are built in over 300 sizes and styles for operation by steam, belt, short belt with idler, gasoline or fuel oil engine, or direct motor drive in capacities up to 5,000 cu. ft. of free air per minute.

Send for Bulletins

CHICAGO PNEUMATIC TOOL COMPANY

CHICAGO, 1027 Fisher Bldg. BRANCHES EVERYWHERE **52 Vanderbilt Ave., NEW YORK**

Machinery Illustrators

Half Tones and Zinc Etchings

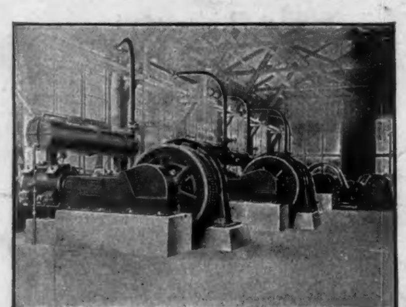
PHOTO RETOUCHING

Specialists In WASH AND LINE DRAWINGS

JEWETT

24-26 Stone Street New York City

CORRESPONDENCE SOLICITED



Bury Single Stage Motor Driven for Short Belt Drive with Floating Idler Pulley

Bury 2 Stage, 3 Cylinder Variable Volume Direct Connecting with Synchronous Motor on Shaft

Bury Compressor Co.

Erie, Pa.